Comments on the Environmental Protection Agency's Proposed Rule for Implementing Changes to the Renewable Fuel Standard

74 Fed. Reg. 24904 (May 26, 2009)
EPA-HQ-OAR-2005-0161; FRL-8903-1

Comments by:

CLEAN AIR TASK FORCE

FRIENDS OF THE EARTH

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I. Introduction

The Clean Air Task Force (CATF) and Friends of the Earth (FOE) appreciate this opportunity to comment on EPA's proposed rule concerning "Regulation of Fuels and Fuel Additives: Changes to the Renewable Fuel Standard Program"[1] (referred to throughout these comments as the "RFS2"). Our organizations have closely participated in this rulemaking, and we want to begin by acknowledging the diligence and openness exhibited by the Environmental Protection Agency (EPA) throughout the process. We look forward to continuing to work with the Agency as it finalizes the RFS2.

In conjunction with many other environmental organizations, CATF and FOE have today submitted a separate set of wide-ranging comments on the proposed RFS2 rule (hereinafter the "Environmental Community Comments"). In those comments, we find "that the general outline of how [EPA] would administer the RFS2 aligns well with our own interpretation of the law."[2] We also provide suggestions for how EPA can improve six facets of the rule. Specifically, the Environmental Community Comments indicate that the Agency must:

- Account for the full lifecycle impact of biofuels, using the best available science, in order to ensure emissions reductions;
- Define renewable biomass in a manner that steers the industry to the most sustainable sources of biomass;
- Ensure that the lifecycle assessment is transparent and based on the best available assessments of agricultural markets and land-use change;
- Confine the timeframe of the lifecycle emissions analysis to no more than 30 years;
- Limit the grandfathering provisions to the language of the Energy Independence and Security Act of 2007 (EISA); and
- Ensure that the waiver provisions are used to avoid unintended economic or environmental harm.

Each of these recommendations is described in detail in the Environmental Community Comments, which are appended here.

The purpose of this submission by CATF and FOE is to supplement the guidance we have provided to EPA in the broader Environmental Community Comments by providing the Agency with additional analysis of particular aspects of its proposal as well as detailed recommendations concerning several issues on which the Agency specifically requested comment. This submission is complementary to and fully consistent with the Environmental Community Comments.

In these comments, CATF and FOE address the following topics:

[1] 74 Fed. Reg. 24094 (May 26, 2009).
[2] Environmental Community Comments at 1.

- EPA's legal obligation under EISA to consider international greenhouse gas (GHG) emissions and indirect land use change (ILUC) emissions in lifecycle emissions assessments. See *Section II*.

- EPA's proposed method for assessing international ILUC. See *Section III*, in which we find that while EPA's approach is generally sound, its analysis must be improved through the use of additional datasets and methodologies. Also in *Section III*, we show that recent research on climate change "tipping points" supports our position that EPA must not use analytic timeframes in GHG emission accounting of greater than 30 years.

- The need for EPA to review and update its methodology for analyzing lifecycle GHG emissions every three years, so as to ensure its analysis is the state-of-the-art. See *Section IV*.

II. Consideration of International GHG Emissions and Indirect Land Use Changes in the Lifecycle GHG Emissions Assessments is Statutorily Mandated and Fundamental to Achieving EISA's Purpose

As EPA has recognized in its proposed endangerment finding, climate change does not present "a close case," and "[i]n both magnitude and probability, [it] is an enormous problem."[3] President Obama has recently called the effects of climate change "potentially cataclysmic".[4] Thus, developing effective strategies to slow climate change and lessen the attendant dangers is imperative.

Congress sought to ensure that EISA would contribute to this effort by making several changes to the RFS. First, EISA dramatically expands the renewable fuel volume requirements. Second, EISA predicates the eligibility of most of the mandated fuels on the fuel's ability to achieve GHG reduction thresholds as compared to the fossil fuels they will replace. EISA requires EPA to conduct a lifecycle GHG emissions analysis that takes into account "the aggregate quantity of greenhouse gas emissions . . . related to the full fuel lifecycle,"[5] an analysis that is the first of its kind in federal legislation.

EPA correctly recognizes that mitigating climate change is a core purpose of EISA:

> These thresholds, in combination with the renewable fuel volume mandates, are designed to ensure significant GHG emission reductions

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[3] Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 18,886, 18904 (Apr. 24, 2009).
[4] Remarks by President Obama and Chancellor Merkel of Germany, June 5, 2009 (Dresden, Germany), *available at* http://www.whitehouse.gov/the_press_office/Remarks-By-President-Obama-And-Chancellor-Merkel-In-Press-Availability-6-5-09/.
[5] CAA § 211(o)(1)(H).

from the use of renewable fuels and encourage the use of GHG-reducing renewable fuels.[6]

Given this purpose, EPA has interpreted the lifecycle GHG emissions analysis mandated by section 211(o)(1)(H) as requiring an analysis of the direct and significant indirect emissions related to a fuel's full lifecycle that occur both in the United States and in other countries.[7] We concur with EPA's interpretation; any other interpretation would be devoid of both legal and scientific support and would undermine EISA's central purpose of reducing GHG emissions.

This section of the comments details why EPA's proposed interpretation of its legal obligation under the statutory mandate is correct and must be adopted in the final rule. Specifically, we explain why EPA is obligated to address GHG emissions resulting from increased biofuel demand in the United States that occur both domestically and internationally. Second, we discuss why EPA correctly interprets EISA to require an analysis of indirect land use changes resulting from increased biofuel production, particularly on the international level. Finally, we explain why uncertainty in the lifecycle analysis does not override the statutory mandate to conduct a GHG lifecycle assessment.

A. EISA Requires a Comprehensive Assessment of GHG Emissions Related to the Fuel Cycle that Occur Both Within the United States and Internationally

Reducing GHG emissions from the transportation sector is a core purpose of EISA and thus its effective implementation requires a comprehensive assessment of the program's impact on GHG emissions. To be eligible as a "renewable fuel," most RFS-mandated fuels must meet certain threshold reductions of GHGs as compared to fossil fuels, specifically gasoline and diesel.[8] These reductions must be based on the "lifecycle greenhouse gas emissions" of the fuel "as determined by the Administrator" (the "lifecycle GHG emissions analysis").[9]

As the definition of lifecycle GHG emissions is central to EISA, it merits repeating the definition in its entirety:

> [t]he aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the Administrator, related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate

[6] 74 Fed. Reg. at 25021.
[7] *Id.* at 25020.
[8] CAA § 211(o)(1).
[9] *Id.* §211(o)(1)(B), (D), & (E).

consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.[10]

The plain language of EISA makes clear that when determining the lifecycle GHG emissions of a given fuel, EPA is to make a broad and comprehensive assessment, as signaled by the deliberately expansive phrases "aggregate quantity" and "related to the full fuel cycle" and the express inclusion of both direct and indirect emissions.

EPA in the proposed rule correctly concludes that there is no legally or scientifically defensible basis upon which to exclude GHG emissions that occur internationally as a result of biofuel production mandated by EISA. Ignoring such emissions would result in a grossly understated lifecycle analysis that "bears no apparent relationship to the purposes of [EISA]" or the real world impact of these fuels.[11] Specifically, EPA interprets the statutory mandate as the following:

> EPA believes that compliance with the EISA mandate – determining the aggregate GHG emissions related to the full fuel lifecycle, including both direct emissions and significant indirect emissions such as land use changes – makes it necessary to assess those direct and indirect impacts that occur not just within the United States and also those that occur in other countries.[12]

We agree that EISA requires an assessment of GHG emissions that occur internationally. For the reasons explained herein, this question is answered under step one of the familiar *Chevron* analysis – *i.e.*, that "Congress has directly spoken to the precise question" of inclusion of international GHG emissions and that EPA's interpretation properly gives effect to the "unambiguously expressed intent of Congress."[13]

First, the definition of "lifecycle greenhouse gas emissions" makes no distinction between emissions that occur domestically and internationally. Rather, the central terms "aggregate" and "full fuel lifecycle" are unqualified and absolute, leaving no room for interpretation. Second, EISA makes no distinction between imported and exported fuels – either the baseline fossil fuels or the renewable fuels – for which EPA must analyze lifecycle GHG emissions.[14] This makes sense given the realities of the production of fuel consumed by the United States transportation sector. EISA requires that EPA conduct a "baseline lifecycle greenhouse gas emissions" assessment of gasoline and diesel sold or distributed in the transportation sector in the United States in 2005

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[10] *Id.* § 211(o)(1)(H).
[11] 74 Fed. Reg. at 25023.
[12] *Id.* at 25020.
[13] *Chevron U.S.A. Inc. v. Nat'l Resources Def. Council, Inc.*, 467 U.S. 837, 842-843 (1984) (hereinafter "*Chevron*").
[14] CAA § 211(o)(1)(B) (definition of advanced biofuel), (C) (defining "baseline lifecycle greenhouse gas emissions" with respect to "gasoline or diesel . . . sold or distributed as transportation fuel in 2005"), (D) (definition of biomass-based diesel), (E) (definition of cellulosic biofuel), & (I) (definition of renewable biomass).

("baseline fuels").[15] As EPA correctly recognizes, "GHG emissions associated with extraction and delivery of crude oil imported to the U.S. all have occurred overseas. In addition, for imported gasoline or diesel, all of the crude extraction and delivery emissions, as well as emissions associated with refining and distribution of the finished product to the U.S. would have occurred overseas."[16] The same is true for renewable fuels whose feedstock is grown and/or processed overseas.[17]

Moreover, EISA clearly contemplates that imported biofuels will be eligible to meet EISA's volume mandates and, thus, that they would necessarily be subject to mandatory lifecycle GHG emissions analysis. For instance, the definition of "advanced biofuel" specifically includes "ethanol derived from sugar."[18] As EPA notes, and Congress was no doubt aware, "[v]irtually all the ethanol from sugar cane is expected to be imported from Brazilian production."[19] Thus, if overseas GHG emissions are excluded, there is no way to ensure that the statutorily mandated GHG emissions reduction thresholds are met. Taken to its logical conclusion, exclusion of overseas GHG emissions would create one of two arbitrary results – neither of which was intended by Congress nor supported by the statutory language. The first would be that imported renewable fuels would receive preferential treatment as many of their GHG emissions (including direct emissions) would be excluded, while identical emissions would be included for fuels of the same type produced domestically. The second result would be *per se* exclusion of imported fuels from eligibility to meet the volume mandates because, without assessing international emissions, EPA cannot ensure that they would meet the GHG emissions reductions thresholds. Yet, this second conclusion is foreclosed by the fact that Congress clearly contemplated that imported fuels would be eligible to meet the volume mandates of EISA.[20]

Congress's inclusion of the phrase "as determined by the Administrator" in section 211(o)(1)(H) does not undermine this conclusion. That phrase indicates that the Administrator is responsible for calculating "aggregate quantity of greenhouse gas

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[15] *Id.* § 211(o)(1)(C).
[16] 74 Fed. Reg. at 25023.
[17] *Id.* at 25024.
[18] CAA § 211(o)(1)(B)(ii)(II).
[19] 74 Fed. Reg. at 25044. In the Draft Regulatory Impact Analysis, EPA explains that "[c]urrently, there are no U.S. plants producing ethanol from sugar feedstocks," although there are plans to begin such operations. EPA, Draft Regulatory Impact Analysis: Changes to the Renewable Fuel Standard (hereinafter "DRIA"), 13-14.
[20] Nor does consideration of the emissions that occur internationally constitute impermissible international regulation by EPA. As EPA correctly explains:

> EPA's regulatory action involves classification of products either produced in the U.S. or imported into the U.S. EPA is simply assessing whether the use of these products satisfies requirements under the Clean Air Act for the use of designated volumes [mandated by EISA]. Considering international emissions in determining the lifecycle GHG emissions of the domestically produced or imported fuel does not change the fact that actual regulation of the product involves its use solely inside the U.S.

74 Fed. Reg. at 25023.

emissions" associated with "the full fuel lifecycle" of a particular biofuel.[21] It does not allow the Administrator to ignore emissions that are undoubtedly "related to the full fuel lifecycle," such as those expressly enumerated in section 211(o)(1)(H).[22]

Finally, distinguishing between GHG emissions based solely on international boundaries is devoid of scientific support. Once emitted, GHGs become well-mixed in the global atmosphere and persist for long periods of time.[23] Thus, as EPA recognizes, "GHG emissions impact global warming wherever they occur, and if the purpose is to achieve some reduction in GHG emissions in order to help address global warming, then ignoring GHG emissions because they are emitted outside our borders interferes with the ability to achieve this objective."[24] An analysis that excludes international GHG emissions, as EPA correctly notes, would therefore result in a GHG emissions analysis that "bears no apparent relationship to the purpose of this provision," "bears no relationship to the real world impact of the fuels," and "would be significantly understated."[25]

In the alternative (and without conceding the point), even if not statutorily mandated, inclusion of international GHG emissions is clearly a permissible construction of EISA that easily passes muster under step two of the *Chevron* analysis.[26] Under the second step of the *Chevron* analysis, an agency's construction of a statutory scheme that it is charged with administering must be accorded "considerable weight" and "deference" and should be upheld so long as it is a permissible construction of the statute.[27] The failure to include expressly international GHG emissions in section 211(o)(1)(H) could be construed as a gap that Congress has given EPA authority to fill and thus the agency's interpretation is entitled to great weight.[28] As explained above, EISA makes no distinction between emissions that occur domestically and those that occur overseas. Rather, the only qualification is that the emissions must be "related to the full fuel cycle," and be significant in the case of indirect emissions. Obviously, emissions that occur as a result of feedstock production, distribution, oil extraction, and other processes that occur overseas are so "related."[29] In addition, it is well established that the location of GHG emissions is irrelevant to their contribution to climate change. Thus, as a matter of science, it would be arbitrary to differentiate these emissions based

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[21] CAA § 211(o)(1)(H).
[22] In Section II.C, we explain why we support EPA's conclusion that "[i]t would be arbitrary to assign the indirect emissions to the domestic renewable fuel but not to assign the identical indirect emissions that occur overseas to an imported product," 74 Fed. Reg. at 25024, particularly with respect to international land use changes.
[23] *See, e.g.*, 74 Fed. Reg. at 18888.
[24] *Id.* at 25024.
[25] *Id.* at 25023.
[26] *Chevron*, 467 U.S. at 843.
[27] *Id.* at 843-844. *See also id.* at 844 ("The court need not conclude that the agency construction was the only one it permissibly could have adopted to uphold the construction, or even the reading the court would have reached if the question initially had arisen in a judicial proceeding.")
[28] *Id.* at 844.
[29] *See, infra,* note 36 for a more detailed discussion of the meaning of "related to."

solely on physically irrelevant international boundaries. Therefore, to say that this is a permissible construction – and thus clears the deferential threshold set by *Chevron* – is an understatement.

In sum, EPA's interpretation that international GHG emissions must be included in the lifecycle assessment is firmly grounded in the plain language of the statute. We believe that any other interpretation would be contrary to EISA's plain language. Even if, however, EISA is interpreted to be ambiguous on the issue, EPA's interpretation is entitled to considerable deference, is not arbitrary and capricious, and is supported by the global scientific consensus regarding climate change.

B. Consideration of GHG Emissions from Land Use Changes Related to Increased Demand for Biofuel, Including Land Use Changes that Occur Internationally, is Statutorily Mandated

As explained above, any defensible interpretation of EISA requires GHG emissions that occur internationally be included in the lifecycle GHG emissions analysis. EISA's mandate that the "aggregate quantity" of GHG emissions "related to the full fuel lifecycle" is unambiguous on this point. Thus, EPA properly recognizes that, "[i]t would be arbitrary and capricious to assign the indirect emissions to the domestic renewable fuels but not to assign the identical indirect emissions that occur overseas to an imported product."[30] Here, we explain why EPA's inclusion of international indirect GHG emissions – in particular land use changes occurring internationally – is the proper interpretation of EISA's mandate.

Section 211(o)(1)(H) requires that EPA assess the "aggregate quantity of greenhouse gas emissions" including "significant indirect emissions such as significant emissions from land use changes" provided that they are "related to the full fuel lifecycle." Thus, to be included in the lifecycle GHG emissions assessment, there are only two requirements for indirect emissions: 1) they must be significant and 2) they must be related to the full fuel cycle. The statute does not further define "indirect emissions," "significant," or "related to the full fuel lifecycle." Thus, Congress has charged EPA with interpreting these terms in light of its significant expertise. EPA's proposal to include indirect emissions – in particular emissions from land use changes—constitutes a permissible construction of these two requirements.

As a general matter, EPA considers "indirect emissions as those from second order effects that occur as a consequence of the full fuel lifecycle."[31] It further notes that "[i]ndirect emissions would include other emissions impacts that result from fuel production or use, such as changes in livestock emissions resulting from changes in livestock numbers, or shifts in acreage between different crop types."[32]

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[30] 74 Fed. Reg. at 25024.
[31] *Id.* at 25023.
[32] *Id.*

To qualify as an eligible renewable fuel, fuels must be produced from "renewable biomass."[33] "Renewable biomass" includes only:

- Planted crops and crop residue harvested from agricultural land cleared or cultivated at *any time prior to enactment of this sentence* that is either actively managed or fallow, and nonforested.
- Planted trees and tree residue from actively managed tree plantations on nonfederal land *cleared at any time prior to enactment of this sentence*[.]
- Animal waste material and animal byproducts.
- Slash and *precommercial* thinnings that are from non-federal forestlands[.][34]

Congress thus limited the direct land use impacts that could result from EISA. EPA correctly notes that "[t]he definition of indirect emissions specifically includes 'land use changes' which would include changes in the kind of usage that land is put to such as changes in forest, pasture, savannah, and crop use."[35] If Congress did not intend that indirect emissions from these land use changes be included, then inclusion of that term in section 211(o)(1)(H) would be superfluous.

The emissions from the types of land use changes that EPA proposes to include are undoubtedly "related to the full fuel cycle" as required by EISA.[36] As EPA correctly explains, increased demand for biofuels as a result of the statutory mandates of EISA will directly result in land use changes both domestically and internationally:

> There is a direct relationship between [the] shifts in the agriculture market as a consequence of the increased demand for biofuels in the U.S. Increased U.S. demand for biofuel feedstocks diverts these feedstocks from other competing uses [food consumption], and also increases the

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[33] CAA § 211(o)(1)(J) ("The term 'renewable fuel' means fuel that is produced from renewable biomass and that is used to replace or reduce the quantity of fossil fuel present in transportation fuel.")

[34] *See id.* § 211(o)(1)(I) (emphasis added).

[35] 74 Fed. Reg. at 25023.

[36] CAA § 211(o)(1)(H). EPA's interpretation of the phrase "related to" as "broad and expansive" and as "meaning to have a connection to or refer to a matter" is well-founded in jurisprudence. 74 Fed. Reg. at 75024; *see Morales v. Trans World Airlines, Inc.*, 504 U.S. 374, 383 (1992) (defining the phrase "relating to" as "to stand in some relation; to have bearing or concern; to pertain; refer; to bring into association with or connection with") (citing Black's Law Dictionary 1158 (5th ed. 1979)). Determinations about whether a connection, reference, or association is overly tenuous are made in light of the objectives of the statute. *New York State Conf. of Blue Cross & Blue Shield Plans v. Travelers Ins. Co.*, 514 U.S. 645, 656 (1995). As explained above, one of the core purposes of EISA is to reduce GHG emissions. To ensure that use of renewable fuels in fact achieves these reductions, Congress has mandated that EPA conduct a lifecycle GHG emissions assessment for each biofuel. And surely, emissions of GHGs resulting from the displacement of food crops to meet EISA's mandates are connected to the "full fuel lifecycle" of a biofuel.

> price of the feedstock, thus spurring production. To the extent feedstocks like corn and soybeans are traded internationally, this combined impact of lower supply from the U.S. and higher commodity prices encourages international production to fill the gap.[37]

Moreover, EPA's own lifecycle GHG emissions analyses show that the GHG emissions from land use changes that occur internationally are no doubt "significant," under any definition of that term.[38] EPA specifically includes two types of GHG emissions in its modeling of ILUC, soil carbon emissions and foregone forest sequestration. EPA estimates that land use conversion will result in soil carbon emissions that would continue to be released for approximately 20 years.[39] Furthermore, the Agency estimates foregone forest sequestration associated with forest clearing would continue for approximately 80 years.[40] We specifically support EPA's use of foregone sequestration from forests in the lifecycle assessments for GHGs, as it contributes significantly to GHG emissions over the course of many years.[41]

Only a cursory review of EPA's modeling is needed to demonstrate that emissions from international land use changes are "significant" in the case of certain biofuels. While not distinguishing between domestic and international land use changes, the following figure provided by EPA is particularly instructive:[42]

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[37] 74 Fed. Reg. at 25024. In fact, EPA's methodology with respect to domestic land use changes is overly conservative as it assumes that 32 million acres of land currently in the Conservation Reserve Program, which is voluntary, will not be converted to crop land despite the fact that increased demand for biofuels will increase the price of crops and hence the value of the land in the CRP. *Id.* at 25032.

[38] EISA does not define "significant," thus leaving EPA substantial discretion to interpret that term. *Chevron*, 467 U.S. at 844.

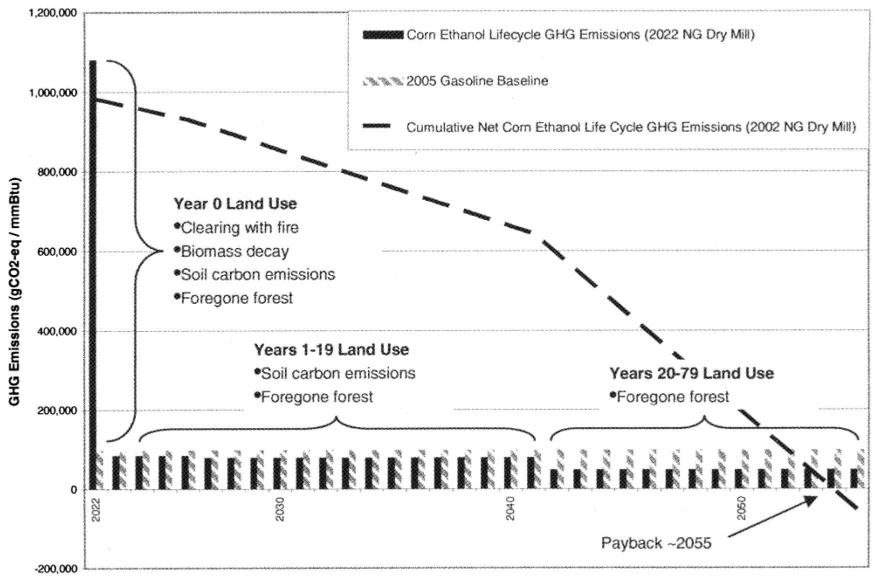
[39] 74 Fed. Reg. at 25033-25034.

[40] *Id.* at 25034. Estimates of annual foregone sequestration from converted forest are from the IPCC guidelines for Agricultural Forestry and Other Land Use. *Id.*

[41] *Id.* at 25032. In fact, EPA's estimates of GHG emissions from indirect land use changes that occur domestically may be overly conservative because EPA has not included in the analysis conversion of forestland as a result of the increased biofuels demand. *Id.* at 25030. EPA plans to include the forestry component in its analysis for the final rule. *Id.* at 25087.

[42] *Id.* at 25034.

Figure VI.B.5-1
Corn Ethanol Lifecycle GHG Emissions over Time and Payback Period



As can be seen, land use changes result in significant, upfront releases of GHGs. Therefore, it can take many years for the benefits of the biofuels to make up for this large initial release (referred to in the EPA figure above as the "payback period"). For instance, as EPA's own analysis demonstrates, taking into account indirect land use changes, the payback of switching from fossil fuels to biofuels does not occur until 2055.[43]

The results of EPA's modeling erase any doubt that for some feedstocks, emissions from international land use changes are indeed significant. Specifically, for corn ethanol, EPA's modeling shows that emissions from international land use changes will account for 61% of the total lifecycle GHG emissions using a 30-year timeframe with no discount rate.[44] The analysis further demonstrates that "excluding international land use change would result in corn ethanol having a 60% reduction in lifecycle GHG emissions compared to petroleum gasoline" regardless of the timeframe and use of a discount rate.[45] With respect to switchgrass cellulosic ethanol, although the emissions from

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[43] *Id.* at 25034.
[44] *See id.* at 25041 (Table VI.C1-1 – Absolute Lifecycle GHG Emissions for Corn Ethanol and the 2005 Petroleum Baseline).
[45] *See id.* at 25042. Using a 100-year timeframe with a 2% discount rate, reductions in GHG emissions from ethanol would be 16%, whereas using a 30-year time frame with no discount rate, corn ethanol would result in a 5% *increase* in GHG emissions as compared to baseline fuels. *Id.*

international land use change are expected to be "modest," they are nonetheless the largest contributor using a 30-year time frame.[46]

Finally, and most dramatically, emissions from international land use changes with respect to soy-based biodiesel not from waste grease constitute 82% using a 30-year timeframe.[47] The modeling demonstrates that "excluding the international land use change would result in soy-based biodiesel having an approximately 80% reduction in lifecycle GHG emissions compared to petroleum regardless of the timing or the discount rate used."[48] In fact, inclusion of emissions from land use changes has a significant regulatory impact as they show that soy-based biodiesel not from waste grease cannot meet the statutorily mandated reduction threshold of 50% in order to comply as an "advanced biofuel."[49] As a result, EPA has excluded soy-based biodiesel not from waste grease from eligibility of meeting EISA's advanced biofuel volume mandates. Nonetheless, soy-based biodiesel could still compete for the conventional "renewable fuel" allotment. This demonstrates why an accurate and comprehensive assessment of the lifecycle GHG emissions from a given fuel is imperative if EISA is to be implemented effectively and achieve its purpose of reducing GHG emissions.

EISA mandates that significant indirect emissions from land use changes "related to the full fuel lifecycle" be included in the GHG lifecycle assessment. Land use changes, and their attendant GHG emissions, that occur as the direct result of displacement of food crops to provide biofuel stock undoubtedly satisfy the requirement that they be "related to the full fuel lifecycle." In addition, EPA's modeling leaves no room for doubt that these emissions are "significant."

C. Uncertainty Does Not Invalidate the Mandate to Conduct the Lifecycle GHG Emissions Analysis, and EPA's General Proposed Approach Is Proper

EISA's mandate to assess the aggregate emissions of GHGs related to the full lifecycle of a biofuel is innovative and the first of its kind in federal legislation. Conducting lifecycle assessments of GHG emissions is a complex process requiring substantial expertise that is still being developed. Nonetheless, it is a statutory mandate that EPA is required to follow. Here we explain why uncertainty in the results of the lifecycle GHG emissions analysis does not invalidate the requirement that EPA conduct a separate analysis to determine a biofuel's eligibility under EISA. We also explain why EPA's approach as a general matter is legally proper, while pointing out some improvements to the analysis (discussed in a Section III) that we urge EPA to adopt. Finally, we highlight steps that EPA has taken to reduce uncertainty in the analysis and steps that EPA should commit

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[46] *See id*. at 25045 (Table VI.C.1-8 – Absolute GHG Emissions for Switchgrass Cellulosic Ethanol and the 2005 Petroleum Baseline).
[47] *See id*. at 25046 (Table VI.C.1-10 – Absolute Lifecycle GHG Emissions for Soybean Biodiesel and the 2005 Petroleum Baseline).
[48] *Id*. at 25047.
[49] *See id*. (Table VI.C.1-12 – Biodiesel Lifecycle GHG Emissions from Different Feedstock and Varied Discount Rates and time Horizons Relative to 2005 Petroleum Baseline).

to undertaking as it gains experience with real-world implementation of the rule and as lifecycle assessment methodologies improve.

It is a fundamental principle of administrative law that "agency determinations based upon highly technical and complex matters are entitled to great deference."[50] It is clear that "EPA has undoubted power to use predictive models . . . but it must explain the assumptions and methodology used in preparing the model and provide a complete analytic defense should the model be challenged."[51] Only if EPA fails to examine all of the relevant data, fails to articulate a satisfactory explanation for its action, or reaches a conclusion that is unsupported by substantial evidence will its selection of technical methodologies be arbitrary and capricious.[52] Finally, it is well-established that uncertainty alone cannot render a decision arbitrary and capricious. As the D.C. Circuit has explained:

> Incomplete data does not necessarily render an agency decision arbitrary and capricious, for "it is not infrequent that the available data do not settle a regulatory issue, and the agency must then exercise its judgment in moving from the facts and probabilities on the record to a policy conclusion."[53]

Moreover, the fact that there is contradictory scientific evidence or that it is disputed does not undermine the deference to be paid to an administrative agency's determination.[54]

In particular, we agree with EPA's conclusion that any uncertainty in the assessment of GHG emissions from indirect land use changes does not invalidate the requirement that they be included in the lifecycle GHG emissions analysis:

> [U]ncertainty in the effects and extent of land use changes is not a sufficient reason for ignoring land use change emissions. Although uncertainties are associated with these estimates, it would be far less scientifically credible to ignore the potentially significant effects of land

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[50] *See, e.g., Appalachian Power Co. v. EPA*, 251 F.3d 1026, 1035 (D.C. Cir. 2001) (internal quotation marks and citations omitted).
[51] *Id.*
[52] *New York v. EPA*, 413 F.3d 3, 18 (D.C. Cir. 2005) (per curiam).
[53] *Id.* at 31 (quoting *Motor Vehicle Manufacturers Ass'n of the United States v. State Farm Mutual Automobile Ins.*, 463 U.S. 29, 52 (1983)).
[54] *Am. Forest and Paper Ass'n v. EPA*, 294 F.3d 113, 122 (D.C. Cir. 2002) ("The presence of disputing expert witnesses offers a classic example of a factual dispute the resolution of which implicates substantial agency expertise and requires that we defer to the informed discretion of the responsible federal agencies." (internal quotations and citations omitted)); *see also New York*, 413 F.3d at 32 ("Nor does the fact that the evidence in the record may also support other conclusions . . . prevent us from concluding that [the agency's] decisions were rational and supported by the record." (internal quotation marks and citations omitted)).

use change altogether than it is to use the best approach available to assess these known emissions.[55]

EPA correctly acknowledges that Congress has explicitly charged the agency with using its technical expertise to analyze and regulate these emissions. Moreover, the case law supports EPA's conclusion that uncertainty alone does not invalidate use of these predictive models to assess significant indirect emissions.[56]

EPA's adoption of methodologies to evaluate the lifecycle GHG emissions of biofuels and the explanation that it provides undoubtedly passes muster under these legal principles. As lifecycle GHG assessments are in the early stages, "[c]urrently no single model can capture all of the complex interactions[.]"[57] Therefore, EPA properly proposes to "use different tools that have different strengths for each specific component of the analysis to create a more comprehensive estimate of GHG emissions."[58] These methodologies, as well as their strengths and weaknesses, are discussed in Section III of these comments and in the Environmental Community Comments. As we explain in Section III, EPA's general proposed approach to analyzing indirect land use emissions is proper and reasonable. We do, however, urge EPA to revise its methodologies in certain significant ways. One such revision is to adopt FAPRI as a single model to analyze both domestic and international emissions. We propose this change based on the recommendations of peer reviewers, which are a result of the evolving understanding of these models and the lifecycle GHG emissions analysis.

We appreciate that EPA is taking a number of steps to reduce these uncertainties and to incorporate the most up-to-date scientific information as it becomes available. First, EPA held a public workshop specifically to solicit feedback on its lifecycle GHG analysis.[59] Second, EPA conducted peer-reviews of its proposed analysis, including its estimations of the impacts of international land use changes, as discussed in Section III below.[60] EPA is also considering country-specific information to better estimate the impacts of international land use changes.[61] In addition, EPA is exploring options to incorporate a formal uncertainty analysis in the final rule and has specifically requested comments on how best to do so.[62]

In short, the fact that the science of lifecycle GHG emissions analysis is evolving and is the subject of uncertainty does not vitiate the statutory mandate that EPA conduct one using the most scientifically sound approaches to date. While we agree in general with EPA's proposed approach, we believe that there are several ways that EPA can improve its analysis, as discussed in Section III of these comments. Finally, we appreciate EPA's

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[55] 74 Fed. Reg. at 25027.
[56] *New York*, 413 F.3d at 31 (quoting *Motor Vehicle Manufacturers Ass'n of the United States v. State Farm Mutual Automobile Ins.*, 463 U.S. 29, 52 (1983). *See also, supra,* notes 53 & 54.
[57] 74 Fed. Reg. at 25025.
[58] *Id.* at 25025.
[59] *Id.* at 25021.
[60] *Id.* at 25021.
[61] *Id.* at 25027.
[62] *Id.* at 25027.

efforts to date to ensure a robust lifecycle GHG emissions assessment and urge EPA to formalize those efforts by requiring in the final rule a mandatory review of the analysis every three years.[63]

III. EPA's Proposed Method for Projecting the Extent and Effect of International ILUC Is a Reasonable Starting Basis But It Must Be Supplemented with Other Datasets and Additional Methodologies

CATF and FOE generally agree that the approach used by EPA to model ILUC outside of the US – which combines projections of the total amount of RFS-driven international land use change generated by FAPRI with Winrock's analysis of remotely observed historical land conversions trends to predict the amount and type of land that will be converted internationally due to the expansion of the RFS – is scientifically and legally appropriate in light of the data and modeling tools currently available to EPA.

Winrock's analysis of MODIS data provides EPA with a reasonable starting basis for projecting future land use changes, but EPA must supplement that analysis with other datasets and additional methodologies that would improve the Agency's ability to determine RFS-related ILUC emissions. As described in greater detail below, we recommend that EPA bolster its analysis for the international land use change patterns – especially for carbon-rich ecosystems – through the use of a longer and more representative comparison period and finer resolution satellite imaging.

A. EPA's Proposed Approach for Modeling ILUC is Appropriate and Reasonable Despite the Associated Uncertainty

EPA uses the results from the FAPRI model of international agricultural trade to estimate how the changes in U.S. agricultural demand and production of renewable fuel feedstocks estimated in the FASOM runs is expected to result in production and acreage shifts in countries that formerly received U.S. exports. The total cropland change from FAPRI is allocated to land uses using the 2001-2004 land use change matrices for 11 countries, and then the carbon contents of vegetation and soils by land use are used to estimate GHG emissions from land use change.

According to EPA, modeling the indirect international emissions associated with the expansion of biofuel production required by the RFS2 may be "the component of our analysis with the highest level of uncertainty."[64] The analytic process EPA has proposed for estimating the acreage, the location, and the type of land that will be converted internationally in response to the RFS scale-up, as well as the amount of resulting GHG emissions, is undeniably complex and dependent on numerous assumptions.

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[63] *See* Section IV, *infra*.

[64] 74 Fed. Reg. at 25027.

The fact that ILUC emissions are not perfectly understood is not a reasonable basis for ignoring them, however. First, as discussed above, Congress explicitly required EPA to account for "significant indirect emissions such as significant emissions from land use change" that are "related to the full fuel cycle" when calculating biofuels' lifecycle greenhouse gas emissions, even though the tools necessary to perform that calculation were still very much under development when EISA was enacted in 2007.[65] There is no doubt that ILUC emissions are "significant," nor that they are "related" to the production of many of the biofuels that might qualify for RINs under the RFS2. EPA is therefore obligated to use the best tools available to it to assess and regulate indirect emissions.[66]

Second, implementing the RFS2 without accounting for ILUC would be logically indefensible. As Searchinger has explained, "[d]iverting [the] plant producing capacity of land to biofuels does not inherently create any net gains [in carbon sequestration], as people must in some form use the plant-producing capacity of other land to replace any diverted food."[67] A comprehensive assessment of the net GHG impacts associated with biofuel production and consumption cannot ignore the second part of this equation. "Calculating direct or indirect land use change is necessary to calculate the extent of any net gains by subtracting the carbon costs of devoting land to fuel when also calculating the carbon benefits."[68]

A group of prominent researchers – including climate specialists Socolow, Pacala, and Williams, as well as biofuel experts like Searchinger, Somerville, and Tilman – recently distinguished between, on the one hand, "good public policy" that can help "ensure that biofuel production optimizes a bundle of benefits, including real energy gains, greenhouse-gas reductions, preservation of biodiversity, and maintenance of food security," and, on the other hand, policies that fail to protect and promote these goals.[69] The researchers placed EISA in first category because the law takes "partial steps in the right direction by specifying minimally acceptable greenhouse benefits for certain types of biofuels" and because it requires that "both direct and indirect emission are taken into account" when a fuel's lifecycle GHG emissions are quantified.[70] The obvious implication is that absent this requirement, EISA and the RFS2 would no longer constitute "good public policy." In sum, as Gibbs writes in her peer review submission to EPA, "Neglecting these emissions could lead to unintentional increases rather than

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[65] CAA § 211(o)(1).
[66] *Accord* 74 Fed. Reg. at 25023.
[67] Timothy D. Searchinger, "Why Uncertainty in Modeling Indirect Land Use Change From Biofuels Cannot Justify Ignoring It" (July 14, 2009), at 2, *available at* http://www.catf.us/projects/climate/biofuels/.
[68] *Id.*; *see also* 74 Fed. Reg. at 25023 ("Drawing a distinction between domestic and international emissions would ignore a large part of the GHG emission associated with the different fuels, and would result in a GHG analysis of baseline renewable fuels that bears no relationship to the real world emissions impact of the fuels.").
[69] David Tilman *et al.*, "Beneficial Biofuels–The Food, Energy, and Environment Trilemma," *Science* (July 17, 2009), at 271.
[70] *Id.*

decreases in net GHG emissions to the atmosphere."[71]

Third, by accounting for ILUC emissions, the RFS2 will steer investment and innovation toward the development of transportation fuels that provide actual net climate benefits. "Rather than casting doubt on 2nd-generation biofuels," wrote a collection of scientists from the University of California in a 2008 letter to EPA, "inclusion of the indirect LUC emissions provides precisely the right incentives to ensure that truly low-carbon biofuels will be produced."[72] In contrast, a failure by EPA to measure and regulate ILUC through the RFS2 will encourage the continued development of high-carbon biofuels.

Fourth, we fully agree with EPA that, "[a]though uncertainties are associated with [estimates of effects and extent of RFS-related land use change], it would be far less scientifically credible to ignore the potentially significant effects of land use change altogether than it is to use the best approach available to assess these known emissions."[73] EPA's view that the uncertainty associated with modeling ILUC is not a valid scientific basis for ignoring the effect has been echoed by numerous scientists, including the aforementioned group from the University of California, which wrote:

> That some land will be brought from natural conditions into cultivation, with accompanying rapid carbon emissions from the existing vegetation, when ethanol demand is added to whatever other corn the world market would otherwise use, is an inference from absolutely foundational and uncontroverted elementary principles of human behavior, such as the law of demand. Exactly how large the effect is requires sophisticated predictive models and will never be as precise as measuring the specific gravity of ethanol, but to act as though the effect is nil is simply obscurantist and unscientific. No principle of law or regulatory practice or common sense dictates that the state must regard any uncertain value as zero.[74]

For the reasons outlined above, EPA cannot finalize rules for implementing the RFS2 that fail to assess and regulate ILUC emissions.

B. The Use of FAPRI Data Combined with Winrock's Analysis of Remotely Observed Land Conversions Data Is a Scientifically Credible Modeling Approach

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[71] ICF International, "Emissions from Land Use Change due to Increased Biofuel Production: Satellite Imagery and Emissions Factor Analysis – Peer Review Report" (July 31, 2009) (hereinafter "ILUC Analysis Peer Review"), B-1.

[72] Letter from Michael O'Hare *et al.* to EPA Administrator Stephen Johnson and USDA Secretary Ed Shafer, on the treatment of iLUC in the RFS2 (Nov. 10, 2008) (hereinafter "O'Hare letter (2008)"), 3, *available at* http://graphics8.nytimes.com/images/blogs/greeninc/EPA_Letter.pdf; *see also* http://www.ucsusa.org/clean_vehicles/what_you_can_do/scientists-letter-iLUC.html.

[73] 74 Fed. Reg. at 25027.

[74] O'Hare Letter (2008) at 4.

As detailed in the Environmental Community Comments, CATF, FOE, and other environmental organizations are concerned about potential inconsistencies from the dual use of FAPRI and FASOM models. At present those models are run separately, with the domestic agricultural changes estimated by FAPRI impelling international changes. EPA relied on the FASOM model, which covers only the United States and generates emissions data endogenously, to estimate the domestic emissions; it used FAPRI model results, combined with an analysis of remotely observed data on land use changes, to estimate international emissions. Peer reviewers Wang and Searchinger pointed to potential and apparent actual inconsistencies in this approach.[75] Banse pointed out in his peer review submission that it is logically possible to meld models, but only if they are used iteratively: in other words, only if domestic FASOM model results were used to drive FAPRI international results or visa versa.[76] The FAPRI model contains both domestic and international results, and could therefore be extended to cover domestic emissions as well. We believe that adopting FAPRI as a single model would be an appropriate way to resolve the inconsistencies.

In the absence of a single model capable of accurately projecting international ILUC, however, the best approach for assessing emissions from ILUC is to amalgamate the strongest aspects of various modeling systems.

Consequently, we generally agree that the approach used by EPA to model ILUC outside of the US – which combines projections of the total amount of RFS-driven international land use change generated by FAPRI with Winrock's analysis of remotely observed historical land conversions trends to predict the amount and type of land that will be converted internationally due to the expansion of the RFS – is reasonable in light of the data and modeling tools currently available to EPA. "[C]arbon stock estimates for broad forest strata or categories that can be linked to satellite-based deforestation and forest degradation analyses will likely be the most feasible approach to quantify carbon emissions for references scenarios," note Olander et al.[77]

There is nonetheless substantial room for improvement in EPA's approach and we suggest several specific enhancements in subsections C through I, below. More generally, we urge EPA to support the development of better analytic tools and better data, both in the course of finalizing this rule and as it conducts periodic reviews (see Section IV, below). In her peer review submission, Gibbs endorses the combined use of remote sensing data and agricultural sector equilibrium models as "the best approach given our available tools."[78] However, she writes, "As we move forward, improved and more integrated modeling and observation systems will be available that will provide improved results."[79]

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[75] *See* ICF International, "Lifecycle Greenhouse Gas Emissions due to Increased Biofuel Production: Model Linkage – Peer Review Report" (July 31, 2009) (hereinafter "Model Linkage Peer Review"), C-6, E-8.
[76] *Id.* at B-6.
[77] Lydia P. Olander *et al.*, Reference Scenarios for Deforestation and Forest Degradation in Support of REDD: A Review of Data and Methods (Environ. Res. Lett. 2008), 9.
[78] ILUC Analysis Peer Review at B-2.
[79] *Id.*

Better tools for modeling the GHG emissions associated with indirect land use are under development, and we expect that EPA will incorporate such models into the process of evaluating the net climate impact of biofuels under the RFS. We look forward to helping EPA identify and evaluate alternative modeling approaches as they are developed.

C. EPA Has Reasonably Assumed That Historical Land Use Changes Will Continue to be Followed in Response to Increased Agricultural Demand Associated With Biofuel Policy

We agree with EPA and each of the five peer reviewers that the use of historical trends in land use changes is a scientifically justifiable method for projecting future conversions.

As noted by Gibbs and other peer reviewers, there are few other options for projecting future land use changes.[80] Given the unanimous support among EPA's peer reviewers for the use of historical land use trends as a predictor of future changes, as well as the lack of alternatives, the Agency's reliance on MODIS data to determine "the quantity of … significant indirect emissions such as significant emissions from land use change," as required by Congress, is reasonable.

The relationship between past and future land use trends diminishes over time, however. As Houghton points out in his peer review submission, the use of historical trends to project future land use patterns is appropriate "for the near future, meaning 5-10 years," but "not for longer-term projections, such as 25, or more, years."[81]

The unreliability of historical trends as a predictor of longer-term land use change patterns is an additional argument against the use of timeframes longer than 20-30 years when assessing the net emissions of a given biofuel.[82]

D. EPA Must Adopt Alternative Methodologies and Data in Order to Better Link the Impacts of Biofuels to Land Use Change

Winrock's analysis of the 1km x 1km MODIS data from 2001 and 2004 provides EPA with a reasonable starting basis for projecting future land use changes, but EPA can and must supplement that analysis with other datasets and additional methodologies that would improve the Agency's ability to determine RFS-related ILUC emissions.

In particular, we share the concerns expressed by EPA's peer reviewers and others that the Winrock/MODIS approach underestimates the amount of forest and wetlands that

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[80] *Id.*
[81] *Id.* at C-1.
[82] *See* Environmental Community Comments (further discussing the appropriate analytic timeframe).

has been and will be cleared for agriculture.[83] Because the process of converting wetlands and forest to cropland can result in enormous GHG releases, it is imperative that EPA rely on analytic tools that can capture the full extent and effect of these conversions in its RFS2 analysis.[84] A review of Table 1 – which tabulates the data that Winrock generated for land conversion in Brazil – lends credence to these concerns.[85]

Table 1—Land use change matrix from MODIS Satellite interpretation, 2001 to 2004, Brazil

BRAZIL	2004						
2001	**Cropland**	**Forest**	**Grassland**	**Mixed**	**Savanna**	**Shrub**	**Total Hectares 2001**
Cropland	9,477,369	249,901	919,366	4,346,228	8,529,974	116,682	23,639,519
Forest	341,186	379,059,490	1,408,111	1,500,199	15,947,827	1,136,045	399,392,858
Grassland	1,472,851	1,453,441	9,152,627	2,576,107	22,384,406	1,456,720	38,496,152
Mixed	4,918,777	1,813,684	2,064,084	21,433,207	25,956,386	211,126	56,397,265
Savanna	6,004,819	18,614,978	12,295,754	21,595,617	214,505,969	4,698,914	277,716,052
Shrub	304,374	1,281,032	2,190,966	440,100	16,752,860	7,296,200	28,265,531
Total Hectares 2004	22,519,377	402,472,526	28,030,907	51,891,458	304,077,422	14,915,687	823,907,377

According to Winrock's analysis of MODIS imagery, 249,901 hectares of Brazilian cropland that existed in 2001 were converted to forest by 2004 – that is, two-thirds of the amount of forest that was converted to cropland (341,186 hectares) during that same period. Both of these land use conversions are dwarfed by the 919,366 hectares of cropland that was converted to grassland by 2004, and by another 8.5 million hectares of cropland that were converted to savanna. All told, Winrock's data indicate that 9.4 million acres of Brazilian cropland that existed in 2001 was abandoned to grassland or savanna in 2004, an amount equal to the area that remained cropland over that period. Moreover, Winrock analysis shows a nationwide increase in forest area of about 3 million hectares, even though Brazil is the global epicenter of tropical deforestation.[86]

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[83] ILUC Analysis Peer Review at B-6; Model Linkage Peer Review at C-7.

[84] *See, e.g.*, Joseph Fargione *et al*, Land Clearing and the Biofuel Carbon Debt, *Science* (Feb. 7, 2008), at 2 (finding that the carbon debt associated with converting tropical peatland rainforest to palm production could take 840 years to repay); Wetlands International and Delft Hydraulics, "Assessment of CO2 emissions from drained peatlands in SE Asia" (Dec. 7, 2006), at 29 (reporting that almost 12 million hectares of Indonesian peatland had been drained, cleared, and often burned – much of it to make room for oil palm plantations; in the process, approximately two billion metric tons of CO2 are released annually, making peatlands destruction a leading source of global warming emissions.[84])

[85] Table 1 was produced from data collected, tabulated, and analyzed for CATF by Ralph Heimlich of Agricultural Conservation Economics.

[86] In fact, UN FAO data calculates that forest cover in Brazil actually decreased by 15.5 million hectares from 2000-2005 (2005 *Global Forest Assessment*). Statistics are available at http://www.fao.org/forestry/country/32185/en/bra/ .

Gross changes in other categories are similarly perplexing: why, for example, would 18.6 million hectares of Brazilian savanna (7 percent of total savanna in 2001) change to forest by 2004, while 15.9 million hectares of forest changed to savanna over the same period?

The question posed by these anomalies is whether the reported changes are real, or whether they are artifacts of the registration and interpretation process. We are concerned they are symptomatic of limitations in the MODIS/Winrock approach that, among other things, tend to underestimate RFS2-related deforestation. Fortunately, the limitations can be addressed in the final rule.

i. EPA Must Rely on Higher Resolution Imagery

One of the likely reasons forest and wetland conversions are being underestimated, according to Gibbs *et al.* (2007), is that "[t]ropical forests are among the most carbon rich and structurally complex ecosystems in the world and signals from remote-sensing instruments tend to saturate quickly."[87] EPA acknowledges that, "As the land cover maps used for this analysis are coarse resolution … and classified into broad land cover categories, the spectral characteristics of the finer classes may be similar to each other in many cases and thus land use conversions among them could be ambiguous."[88] Similarly, in her peer review submission, Gibbs worries that it is "not clear as to how the MODIS land use change would be able to identify clearance of peat swamp forests in the Winrock analysis" and that, as a result, there "could be a major omission for palm oil expansion in Southeast Asia."[89]

The Winrock/MODIS treatment of carbon-rich tropical forest ecosystems demonstrates the need to use supplemental analyses and empirical data where available in order to provide a fuller and more accurate picture of how the RFS will impact land use change. For example, EPA reports that the MODIS data for Indonesia, Malaysia, and Philippines suggest "large areas of plantation, perennial tree crops (e.g. rubber and palm oil plantations), and the woody formations are classed as forest under the MODIS algorithm."[90] Not surprisingly, all five of the experts who peer reviewed EPA's reliance on Winrock/MODIS data "recommended augmenting the current global analysis with higher resolution analyses where agricultural expansion is likely to be the most intense."[91] As mentioned above, an analytic system that fails to capture carbon-intensive conversions such as tropical forest to palm oil plantation will significantly underestimate associated GHG releases and, in turn, materially affect EPA's implementation of the RFS.

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[87] H K Gibbs *et al*, Monitoring and estimating tropical forest carbon stocks: making REDD a reality, *Environ. Res. Lett.* (Dec. 5, 2007) at 8.
[88] DRIA at 365.
[89] ILUC Analysis Peer Review at B-12.
[90] DRIA at 367.
[91] ILUC Analysis Peer Review at 8.

Consequently, EPA must integrate empirical data and high-resolution satellite imaging into its analysis of ILUC in carbon-rich ecosystems at a minimum. As Gibbs notes in her peer review submission,

> [D]etailed spatial datasets of transportation infrastructure, land ownership, protected areas, human settlements, soils, land suitability, agricultural production and so on could be used to supplement remote sensing data. These supplementary datasets would help better constrain the causes of land use change and help ensure that land use changes rather than just land cover changes were being identified.[92]

EPA's peer reviewers have provided the Agency with a number of options to improve this aspect of its analysis. For example, Houghton recommends that EPA use "multi-temporal" 30m x 30m Landsat Thematic Mapper data "in selected sites to serve as checks to the coarser resolution analyses" based on MODIS.[93] Wardlow suggests the use of MODIS 250m data in "highly fragmented landscapes where multiple land cover types are contained within the 1-km footprint of each MODIS pixel."[94] According to Tullis, EPA's land use change analysis "could significantly benefit from the development of a spatial decision support system," or SDSS, which would allow the Agency to use of global datasets such as the 90m x 90m Digital Elevation Model generated by the NASA Shuttle Radar Topography Mission.[95]

Tullis also points out that the literature provides little support for the use of 1km x 1km data: "[t]he most frequent spatial resolution for land cover analysis in the literature is based on the nominal 30 x 30 m specification associated with the Landsat program"; alternatively, he notes, at least one source "indicates that the MODIS 500 x 500 m data is a candidate for land cover monitoring but doesn't mention using 1 x 1 km data for the same process."[96] He recommends that EPA generally rely on MODIS 500m resolution data, and adds, "This is not a major change in direction since Winrock has already taken steps to test the sensitivity of the analysis."[97]

The unanimous sentiment of the peer reviewers – that EPA must either selectively supplement Winrock's analysis of MODIS data or replace that data altogether higher resolution imagery – is corroborated by the anomalous results generated by Winrock's analysis of MODIS 1km x 1km data (see Table 1, above). EPA will have to determine which of the suggested options for improving remote observation data will best address this shortcoming in its land use change analysis; what is clear, however, is that the Agency must adopt one or more of these proposed fixes.

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[92] *Id.* at B-4.
[93] *Id.* at C-5.
[94] *Id.* at G-1.
[95] *Id.* at E-3; *see also* CGIAR-CSI, SRTM 90m Elevation Data, *available at* http://srtm.csi.cgiar.org/.
[96] ILUC Analysis Peer Review at E-4.
[97] *Id.*

ii. EPA Must Use a Longer and More Representative Comparison Period

We also agree with peer reviewers that EPA needs to use land use change detection data from a longer comparison period. Winrock compared MODIS data of land use in 2001 to data from 2004, and then attempted to characterize the changes that occurred during that period. Houghton points out that if EPA continues to rely on low-resolution MODIS data, "the changes over 3 years may be too small relative to the errors in a single year's classification to get a reliable estimate of what has changed."[98] Accordingly, he urges the Agency to rely on changes observed over 5-10 years, rather than over three years.[99] This suggestion is echoed by Gibbs ("historic reference periods should be measured using remote sensing observations over 5-10 [years] to reduce the impact of anomalous years"[100]) and by Searchinger ("such a short period seems inappropriate and potentially skewed, particularly for modeling long-term effects that will take place as biofuel production expands"[101]).

In addition, it is not clear that 2001-2004 is representative of the longer-term trends in land use change. Forest area has been reported to FAO by countries since 1990, usually on a periodic basis with a multi-year inventory cycle. In a number of countries, the annual change in forest area converged on zero in the 2001-2004 period (decreasing from the previous rate in the U.S., Russia, India, and Malaysia, and increasing from the previous rate in Mexico, Philippines and Argentina). China's rate of forest area gain increased markedly, while Brazil's rate of loss increased. The European Union and Indonesia had little change in their rates. Table 2 compares the average annual net change in forest area from the FAO data for 2001-2004 and 1997-2007 with the average annual net change from MODIS for 2001-2004.[102] The sign of the change (*i.e.*, gain vs. loss) found in the two datasets is different for 7 of the 11 countries (Brazil, India, Indonesia, Malaysia, Mexico, Philippines, and Russia), and the order of magnitude of the change is different for 5 of 11 (Argentina, India, Indonesia, U.S., and especially Russia). The simple correlation between Winrock-MODIS and FAO forest area change is only 9.1%. Meanwhile, forest area change data from FAO in 2001-2004 are highly correlated with change over the longer 1990-2007 period, and reasonably well correlated with shorter periods within that time frame.

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98 ILUC Analysis Peer Review at C-4.
99 *Id.*
100 *Id.* at B-2.
101 Model Linkage Peer Review at C-8.
102 Tables 2 and 3 were produced from data collected, tabulated, and analyzed for CATF by Ralph Heimlich of Agricultural Conservation Economics.

Table 2—Comparing annual net change in forest land use, Winrock-MODIS and FAO							
	Winrock-MODIS	FAO Net annual change in forest area					
	2001-2004	2001-2004	2004-2007	1997-2007	1997-2001	1990-1997	1990-2007
ARGENTINA	-1,141	-150	-150	-150	-112	-149	-149
BRAZIL	1,027	-3,103	-3,103	-2,977	-2,116	-2,681	-2,855
CHINA	2,531	4,058	4,058	3,436	2,007	1,986	2,839
E.U.	637	695	695	711	547	2,550	1,468
INDIA	-394	29	29	129	188	362	225
INDONESIA	42	-1,871	-1,871	-1,871	-1,404	-1,872	-1,871
MALAYSIA	119	-140	-140	-122	-74	-79	-104
MEXICO	354	-260	-260	-287	-239	-348	-312
PHILIPPINES	216	-157	-157	-189	-171	-263	-219
RUSSIA 1/	16,953	-96	-96	-57	-8	32	-28
U.S.	2,435	159	159	221	222	365	280
Correlation with Winrock-MODIS 2001-04	100.0%	9.1%	9.1%	10.0%	11.3%	7.1%	9.0%
Correlation with FAO 2001-04	9.1%	100.0%	100.0%	99.7%	98.3%	85.6%	96.9%
1/ Data for Russian Federation extends only to 1992							

With regard to changes in arable area, 2001-2004 is much higher than typical values over 1977-2007 for Indonesia, Argentina, and the U.S., and lower than average for Malaysia, Brazil, Philippines, the E.U., and Mexico. Rates in China, India, and Russia were representative of the longer period, but China had both high and low rates of change during 2001-2004.

Arable land area has been reported to FAO since 1961 for most countries, so annual average change can be computed for numerous periods, including the 2001-2004 period used by Winrock (see Table 3). Rates for six of the eleven countries have a different sign for average annual change in the 2001-2004 period (Brazil, China, E.U., India, Russia and the U.S.), and for those that agree in sign, rates are off by an order of magnitude for two (Indonesia and Mexico). The simple correlation between 2001-2004 data from FAO and Winrock-Modis is -60.7%, indicating moderately complete disagreement. Correlation between FAO data for 2001-2004 and other periods ranges from a high of 23.5% for 1977-91 to a low of -28.7% for 1991-96, indicating that the 2001-2004 period used by EPA in its land use change analysis is not very representative of longer land used change trends.

Table 3—Comparing annual net change in cropland/arable land use, Winrock-MODIS and FAO							
	Winrock-MODIS Net annual change in cropland	FAO Net annual change in arable area					
	2001-2004	2001-2004	2004-2007	1996-2001	1991-1996	1977-1991	1977-2007
Argentina	1,478	833	667	100	220	29	217
Brazil	-373	112	67	221	1,172	571	517
China	4,818	-174	2,995	1,594	96	1,870	1,437
E.U.	5,646	-705	-521	-1,032	1,470	-190	-138
India	4,323	-279	-267	-243	-168	-66	-154
Indonesia	175	1,489	-889	452	-28	6	133
Malaysia	-51	0	0	-4	4	58	27
Mexico	499	0	-200	20	110	132	63
Philippines	64	5	33	-50	-50	28	0
Russian Federation 1/	7,971	-571	-191	-433	-1,496	0	-696
U.S.	2,348	-385	-1,272	-721	-1,334	-63	-537
Correlation with Winrock-MODIS	100.0%	-60.7%	17.6%	-20.6%	-28.7%	23.5%	-20.7%
Correlation with FAO 2001-04	-60.7%	100.0%	-3.6%	42.4%	11.5%	-7.7%	25.5%
1/ Data for Russian Federation extends only to 1992							

iii. EPA Should Reconsider its Reclassification of Land Cover Categories

EPA seeks comment on its proposed decision to reclassify the 17 land use and land cover classifications presented in MODIS into five categories (cropland, forest, grassland, savanna, and shrubland). While the Agency has a reasonable basis for reclassifying the MODIS data in general, some of the specific reclassification decisions appear to be contributing to the anomalous results found in the Winrock analysis.

For example, the decision to exclude the interpretation class "cropland/natural vegetation mosaic" could reduce the amount of observed land conversion because small changes in cropland within a 1km area of natural vegetation can be missed. Furthermore, EPA's decision to reclassify the "mixed" land use category used in MODIS may amount to a critical omission because the proportion of cropland converted from the "mixed" land use category in MODIS varies from 8 percent in the E.U. to 53 percent in the U.S. (averaging 30 percent overall).

We urge EPA to review its reclassification decisions in light of these concerns and the suggestions offered by the peer reviewers.[103]

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[103] *See, e.g.*, ILUC Analysis Peer Review at B-4, E-5.

iv. EPA Should Consider the Use of True "Change Detection" Analysis

As recommended by Houghton in his peer review submission, EPA should consider conducting a "change detection" approach to analyze land use changes that occurred over the comparison period.[104] "Change detection" analysis lays one image over the other and identifies places where there is a difference. It frees the analyst from having to classify most of the image (areas that have not changed to do not require classification/analysis), and is generally more accurate than differencing two independent MODIS images when the time gap between the two images is short (*e.g.*, three years).

E. EPA Should Continue Working With the GTAP Model to Test The Results Generated by its Primary Approach, But GTAP Should Not Be Used as the Primary Land Use Change Model

In the preamble to the proposed rule, EPA asks for comments on the use of Purdue University's Global Trade Analysis Project (GTAP) model "in helping to establish the GHG emissions estimates for the final rule."[105] EPA should continue to work with GTAP to further its development, and the agency should compare GTAP modeling results to those generated by its proposed combination of partial equilibrium models, but GTAP by itself should not be relied upon for determining the extent and effect of ILUC related to the RFS2 unless and until some of the model's shortcomings are addressed.

GTAP has several promising attributes, but it uses overly coarse feedstock categories, it cannot yet model the impact of increased cellulosic feedstock production, and its strict reliance on economic equilibrium prevents it from "capturing dynamic changes in the global [agriculture] sector"[106] or addressing land use changes in areas such as unmanaged forestland that lack market-based valuation.[107] As noted by Banse in his peer review submission, "Market responses are well covered in PE [partial equilibrium] models due to the fact that both policy details and commodity details are better presented in PE models compared to general equilibrium model[s] which are often [built] on the GTAP data base."[108]

F. EPA Must Include Foregone Sequestration in its GHG Emissions Estimates

We strongly agree with EPA and each of the peer reviewers surveyed by ICF International that foregone forest sequestration must be accounted for when

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[104] *Id.* at C-4.
[105] 74 Fed. Reg. at 25033.
[106] Model Linkage Peer Review at D-3.
[107] *Id.* at C-2.
[108] *Id.* at B-1.

determining the net GHG impact of biofuel production.[109] As EPA writes in the DRIA at 387, "In an avoided emissions scenario, carbon benefits can be generated not only from preventing the immediate loss of biomass carbon stocks, but also from allowing carbon to accumulate over time in the vegetation that would have been cleared." Accordingly, the Agency cannot accurately assess lifecycle GHG emissions for biofuels if it ignores lost forest sequestration.

As EPA acknowledges, "studies have estimated that new forests grow for 90 years to over 120 years" and "[m]ore recent estimates suggest old growth forests accumulate carbon for up to 800 years."[110] EPA should therefore assume a sequestration period of greater than 80 years, as suggested by Gibbs in her peer review submission (indicating at B-13 that Winrock's assumption (adopted by EPA) that forest sequestration continues for 80 years "is likely an underestimation of foregone forest sequestration").

G. EPA Should Base its Soil Carbon Calculations on the Top 30 centimeters of Soil as Long as the Data Is Adjusted to an Equal Volume Basis

EPA has proposed to estimate land use-related emissions of soil carbon stock by taking into account annual changes in the carbon content in the top 30cm of soil. Based on an analysis prepared for CATF by John Kimble[111], we agree EPA can reasonably calculate annual changes in soil organic carbon (SOC) content based on measurements of carbon in the top 30 centimeters of soil *provided* the data is adjusted to an equal volume basis. The top 30cm is where most losses occur with land use changes.

EPA needs to consider the types of post-conversion cultivation practices that will be used as this can have a major impact on changes to SOC. In areas where forestlands are being changed to cropping, soil disturbance can be so deep and mixing can be so significant that the soil carbon profile of the newly-cropped site bears little relationship to that of the native site. In addition, sugar cane tillage often causes soil disturbance well below 30cm.

EPA should consider several recent studies which suggest that changes occur to much deeper depths over time. (See Poirier *et al.* (2009); Baker *et al.* (2007)). (SOC changes may be found at deeper depths in land converted to cropping because tilling makes more material available to be transported down by water to greater depths. Alternatively, it may just be a change in bulk density that would affect the amount when compared on just the basis of depth and not on an equal volume basis.)

In general, measuring SOC to 30cm is what is needed to make determinations of CO_2 given off when native areas are converted to croplands. Some studies have also shown than there is more SOC in forest lands that are converted to grassland, this most likely is

[109] 74 Fed. Reg. at 25032.
[110] DRIA at 388.
[111] Dr. Kimble is the author of, *inter alia*, Kimble *et al.* (Eds.), *Soil Carbon Management: Economic, Environmental, and Societal Benefits*. CRC Press (2007).

the result of more fine roots and grazing pressure that increase below ground biomass and by default SOC. It follows the pattern of Mollisols (grassland soils) having more SOC than Alifsols (forest soils). There is generally less SOC accumulation in the tropics, due to the relative absence of fine roots and the presence of soil-based microorganisms that consume the litter layer very quickly.

Unfortunately, most of the relevant available databases were developed for reasons other than to measure SOC changes and thus lack useful data. EPA should, whenever possible, rely on data developed for specific land uses. A large amount of such data is available in Brazil and can be collected from researchers actively working there on an SOC measuring project.

Going forward, EPA should rely on SOC measurements that conform to the following principles:

- Benchmark Sites: Reference points need to be established in natural areas and in areas that undergo land use change and then sampled. While there are many different ways to do this, a particularly useful approach is defined in the paper by Ellert and Bethany (1995). The sites need to be geo-referenced so that they can be revisited for subsequent sampling, in order to check for changes to the SOC. If areas have already been converted, sampling can be conducted on sites in natural areas and converted areas to look at the changes to SOC. Sites for comparison must be on the same soil and geomorphic landscape position.

- Soil Sampling: Sampling depth needs to be about 10 cm deeper than the desired reporting depth. If data is to be reported to 30 cm then researchers should sample to 40 cm so that data can be adjusted to an equal volume basis as this can make a major difference when comparing results. Bulk samples need to be collected for chemical analysis and samples (cores or clods) need to be collected for bulk density determination.

- Time to Sample and Where: Researchers must establish a consistent interval between initial and subsequent samplings, so as to avoid seasonal variations connected to crop growth, harvest, the rate of decomposition, etc. Tillage can cause major changes in the bulk density, as can harvest traffic.

- Soil maps and problems with the FAO map: EPA has proposed to use soil maps and data from existing soil sampling to generalize SOC changes. This can be done if there are good maps with supporting soils data. However, the FAO map may not be the best soils map to use, as it needs to be combined with climatic data to make determinations of where different soils occur. Because the FAO map does not consider climate to be a major soil-forming factor, it must be overlain with climatic data to be a viable resource. Using existing soil maps and databases can be a useful way to look at past changes and help to predict future changes. However, to effectively do this these soils data need to be stratified by soil type. Soils should be separated by vegetation type and land use (cropped, fallow, forested, rangeland, etc.), although soil databases often fail to elaborate on these factors.

H. The Emission Factors Used by EPA to Quantify Emissions Due to Land Use Change Are Reasonable

EPA's proposal to rely on the land use change emissions factors calculated by Winrock is reasonable, particularly in light of the existing data constraints. The Agency will need to regularly update the emissions factors used in its land use change emissions analysis to incorporate new mapping of soil carbon distribution,[112] better maps of forest biomass,[113] and other improvements.

I. Research on Climate Change "Tipping Points" Supports the Use of an Analytic Timeframe for GHG Emissions Accounting of No Longer than 30 Years

A critical step towards creating intelligent climate mitigation policy is an understanding of Earth "tipping points" – a GHG concentration level and time-span beyond which positive feedback loops take over and significant, unavoidable climate change occurs in various systems. Simply put, it is necessary to know how much carbon must be mitigated, and by when, to avoid the worst-case global warming scenarios. The complexity of Earth's climate system has made it difficult to quantify these sensitivity variables[114,115,116], but in recent years more powerful models have helped build a scientific consensus that this tipping point is closer than we think: 2050, not 2100, may be the more accurate deadline for effective climate mitigation. Below are summaries of seven key "tipping point" articles published (chronologically) in the last two years, as well as their contribution to this growing consensus.

In light of these studies we urge EPA to adopt an accounting timeframe of 30 years or less.

i. Relevant Papers on Tipping Points

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[112] *See* Section III.G, *supra*; ILUC Analysis Peer Review at C-8.
[113] *See* ILUC Analysis Peer Review at B-9.
[114] Roe, G. H. and M. B. Baker. "Why Is Climate Sensitivity So Unpredictable?" *Science* 318 (Oct. 26, 2007): 629-32.
[115] Knutti, R., M. R. Allen, P. Friedlingstein, J. M. Gregory, G. C. Hegerl, G. A. Meehl, M. Meinshausen, J. M. Murphy, G. K. Plattner, S. C. B. Raper, T. F. Stocker, P. A. Stott, H. Teng, and T. M. L Wigley. "A review of uncertainties in global temperature projections over the twenty-first century." *Journal of Climate* 21 (June 1, 2008): 2651-63.
[116] Kriegler, E., J. W. Hall, H. Held, R. Dawson, and H. J. Schellnhuber. "Imprecise probability assessment of tipping points in the climate system." *Proceedings of the National Academy of Sciences* 106 (Mar. 31, 2009): 5041-46.

--Fisher et al. "Issues related to mitigation in the long-term context." In: Metz et al. (Eds.), Climate Change 2007: Mitigation: CUP, Cambridge UK.

This selection from the IPCC report surveyed various climate models to determine that to stabilize atmospheric carbon at 445-490 ppm (equivalent to a 2.0° C to 2.4° C temperature rise based on IPCC climate sensitivity estimates) carbon dioxide equivalent emissions would have to be reduced by *85%* of their 2000 values by 2050. This would mean CO_2 emissions would peak between 2000 and 2015, after that emissions would have to decline. Even a stabilization at 490-525 ppm (the upper limit of estimated "tipping point" values) would require a 30-60% reduction in emissions by 2050, and would result in a 2.4° C to 2.8° C temperature rise.

--Royer et al. "Climate sensitivity constrained by CO_2 concentrations over the past 420 million years." Nature, 2007.[117]

The general scientific agreement is that the Earth's "climate sensitivity" – its response to a doubling of atmospheric carbon – is between 1.5°- 6.2° C (95th percentile). However, these figures are based off of carbon/climate relationships over a few thousand years before present, a period during which carbon levels were lower than today and fairly stable. Because this period does not include the large carbon concentration swing experienced today, these figures may be underestimating Earth's climate sensitivity. This study models climate sensitivity over the last 420 million years (comparing CO_2 concentrations and climate proxies) to conclude that climate sensitivities greater than 1.5° C have been a "robust" feature of the Earth's warming patterns – current models underestimate climate sensitivity.

--Lenton et al. "Tipping elements in the Earth's climate system." Proceedings of the National Academy of Scientists, 2008.[118]

This study identifies 15 Earth systems that have the potential to be a "tipping point" for a larger climate crisis. An example of one such system is Arctic Sea Ice, which after a certain melting point will become trapped in an ice/albedo feedback, amplifying the effects of global warming throughout the entire Arctic region. Other "tipping" systems include the West Antarctic Ice Sheet (WAIS), the Atlantic Thermohaline Circulation (THC), and the Northern Permafrost. Eight of the systems were relatively insensitive and would take more than 100 years to transition to their "tipping" scenario, but the other seven (Arctic summer sea-ice, Indian summer monsoon, West African monsoon, Amazon rainforest tree fraction, Boreal forest tree fraction, and Arctic ozone) were capable of tipping within 50 years if the conditions were correct. As Lenton concluded:

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[117] Royer, D. L., R. A. Berner, and J. Park. "Climate sensitivity constrained by CO2 concentrations over the past 420 million years." *Nature* 446 (May 29, 2007): 530-32.
[118] Lenton, T. M., H. Held, E. Kriegler, J. W. Hall, W. Lucht, S. Rahmstorf,, and H. J. Schellnhuber. "Tipping elements in the Earth's climate system." *Proceedings of the National Academy of Sciences* 105 (Feb. 12, 2008): 1786-93.

“Society may be lulled into a false sense of security by smooth projections of climate change. Our synthesis of present knowledge suggests that a variety of tipping elements could reach their critical point within this century…”

--Hansen et al. “Target Atmospheric CO_2: Where Should Humanity Aim?” The Open Atmospheric Science Journal, 2008.[119]

Fifty million years ago the Earth was ice-free, but as CO_2 levels dropped to below 450 ppm ice caps reformed. With current[120] CO_2 concentrations at 385 ppm and without immediate carbon mitigation strategies, this maximum allowable value of 450 ppm will be reached again *within decades*, after which irreversible climate damage may occur. To maintain risk tolerance below 25% it is necessary to lower current carbon concentrations to 350 ppm or less. Hansen advocates the complete phase-out of non-captured coal emissions by 2030, and immediate implementation of forestry and agricultural practices to sequester carbon. All the models used in this study agree: in order to stabilize CO_2 below 350 ppm without ever peaking above 450 ppm, major steps must be taken by 2030, and concentrations *must be decreasing* by 2050.

--Ramanathan et al. “On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead.” Proceedings of the National Academy of Sciences, 2008.[121]

The world has already committed to significant global warming based on 2005 figures. If CO_2 concentrations held stable at 2005 levels, global temperatures would still increase by 2.4° C (1.4° C to 4.3°C for 95% confidence). This increase range surpasses the 1° C to 3° C increase that the IPCC has labeled as the “threshold” for various tipping elements: summer arctic sea ice melt, Himalayan–Tibetan glaciers retreat, and the Greenland Ice Sheet loss. About 0.6° C of this committed warming has already occurred, and since few climate mitigation scenarios intend to stabilize global CO_2 concentrations at 2005 levels, the additional 1.8° C of committed warming is expected to occur quickly and additional warming beyond 2.4° C is almost certain.

--Solomon et al. “Irreversible climate change due to carbon dioxide emissions.” Proceedings of the National Academy of Sciences, 2009.[122]

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[119] Hansen, J., M. Sato, P. Kharecha, D. Beerling, R. Berner, V. Masson-Delmotte, M. Pagani, M. Raymo, D. L. Royer, and J. C. Zachos. “Target Atmospheric CO2: Where Should Humanity Aim?” *The Open Atmospheric Science Journal* 2 (2008): 217-31.

[120] Circa 2008.

[121] Ramanathan, V. and Y. Feng. “On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead.” *Proceedings of the National Academy of Sciences* 105 (Sept. 23, 2008): 14245-50.

[122] Solomon, S., G. Plattner, R. Knutti, and P. Friedlingstein. “Irreversible climate change due to carbon dioxide emissions.” *Proceedings of the National Academy of Sciences* 106 (Feb. 10, 2009): 1704-09.

Removing GHGs from the atmosphere decreases radiative forcing, but this is largely offset by decreased heat uptake by the oceans. This means that the climate change that occurs in response to carbon emissions is largely irreversible for at least 1,000 years after those emissions end. If the atmospheric concentration of CO_2 was to rise from 385 ppm to 450-600 ppm, irreversible changes would include ice loss, major precipitation reductions in some areas, and significant global sea level rise. The magnitude of this irreversible change is directly linked to the peak concentration of carbon reached: this makes "overshoot" mitigation strategies – where concentrations continue to rise for the next few decades in exchange for major emission drops by the end of the 21st century – unfeasible. As the authors put it, "Understanding of irreversibility reveals limitations in trading of greenhouse gases on the basis of 100-year estimated climate changes, because this metric neglects carbon dioxide's unique long-term effects." Overshoot strategies in the context of the irreversibility of climate change are also challenged in papers by Lowe et al.[123] and Matthews et al.[124]

--Meinshausen et al. "Greenhouse-gas emission targets for limiting global warming to 2 °C." Nature, 2009.[125]

Over 100 countries have set a mitigation goal of limiting climate change to 2° C. This probabilistic analysis finds that the two most influential factors in achieving this goal are cumulative emissions by 2050 and emissions levels in 2050. If cumulative emissions from 2000-2050 can be limited to 1,000 Gt CO2, there is only a 25% chance of exceeding the 2° C goal. If net emissions are constrained to 1,440 Gt CO2 the probability of exceeding 2° C is 50%. Cumulative emissions from 2005-2006 alone were 234 Gt, so to achieve mitigation goals immediate reductions in emission levels must occur. The analysis predicts that if emission levels in 2020 are 25% above 2000 levels, the probability of exceeding 2° C is 53-87%. Performance by the 2050 deadline was an extremely robust climate indicator in the analysis – successful climate mitigation will depend heavily on policy change by the mid-century.

ii. Conclusions To Be Drawn From the "Tipping Point" Literature

Given the complexity of Earth's climate system, there is an inherent difficulty in quantifying climate sensitivity and "tipping point" temperatures. That being said, there has been a general consensus among climate scientists in recent years that: a) the climate sensitivity of Earth may have been underestimated in previous models, b) some sensitive Earth systems can be pushed past a "tipping" point by positive feedback loops

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123 Lowe, J. A., C. Huntingford, S. C. B. Raper, C. D. Jones, S. K. Liddicoat, and L. K. Gohar. "How difficult is it to recover from dangerous levels of global warming?" *Environmental Research Letters* 4 (2009).

124 Matthews, H. D., and K. Caldiera. "Stabilizing climate requires near-zero emissions." *Geophysical Research Letters* 35 (Feb. 27, 2008).

125 Meinshausen, M., N. Meinshausen, W. Hare, S. C. B. Raper, K. Frieler, R. Knutti, D. J. Frame, and M. R. Allen. "Greenhouse-gas emission targets for limiting global warming to 2 °C." *Nature* 458 (Apr. 30, 2009): 1158-62.

once a certain temperature is reached, c) anthropogenic warming is essentially irreversible over historical timescales, d) the extent of this irreversible warming is determined by maximum CO2 level reached, and e) a large portion of the warming is already unavoidable or will become unavoidable in the near future.

In regards to climate mitigation, the scientific agreement is that 2100 is not an adequate timescale for CO2 reduction. Given the sensitivity of the Earth system and the current pace of GHG emissions, mitigation by 2100 will result in significant irreversible warming as well the "tipping" of various climate systems. In order to contain global warming, major steps must be taken prior to 2050, perhaps even 2030. Thus, we urge EPA to use an accounting timeline that assesses the impact of RFS2 on GHG emissions over the next two to three decades, not over the next 100 years.

IV. The Final RFS2 Regulations Should Require Review of EPA's Lifecycle GHG Emissions Analysis and Fuel-Specific GHG Emissions Estimates Every Three Years

EPA correctly recognizes that the lifecycle GHG emissions analysis required by section 211(o)(1)(H) is a key component to the successful implementation of EISA. In addition, EPA correctly recognizes that "the state of the science for lifecycle GHG analysis will continue to evolve over time as new data and modeling techniques become available and as there are improvements in agricultural and renewable fuel production practices as well as new feedstocks."[126] As a result, EPA proposes in the preamble of the proposed RFS2 to review and update the methodology every three to five years "to ensure that this methodology takes into account the most state-of-the-art science."[127] We agree with EPA that periodic review is necessary to ensure a continuously robust and state-of-the-art lifecycle GHG emissions analysis. We are concerned, however, that the periodic review approach described in the preamble could fall short of achieving this goal, and we urge the Agency to make the following changes.

First, and most importantly, the final rule should clarify that periodic review and assessment of the lifecycle GHG emissions analysis and resulting fuel-specific GHG emissions estimates is mandatory. To that end, EPA must insert a new section in the final rule setting forth the review requirements.

Second, EPA's periodic reviews and assessments should, at a minimum, appraise 1) the modeling techniques and data used in the Agency's existing lifecycle GHG emissions analysis, 2) any new peer-reviewed modeling techniques and any new data that might reasonably improve EPA's analysis of lifecycle GHG emissions, 3) the accuracy of EPA's fuel-specific GHG estimates for biofuels made from existing feedstocks, and 4) GHG emissions estimates for biofuels made from any new feedstocks.

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[126] 74 Fed. Reg. at 25041.
[127] *Id.*

Third, the final rule should provide a definite timeframe during which EPA must commence and complete this review, instead of the "3-5 year[]" period proposed by EPA[128]. EPA should begin the first review no later than three years after the effective date of the regulations and complete the review no later than one year thereafter. Subsequent reviews would follow the same schedule beginning after the completion of the first review. This timeframe provides EPA with ample time to conduct a thorough review, while simultaneously reducing uncertainty for stakeholders regarding the timing of EPA's review. Furthermore, this shorter, three-year review period is appropriate given the rapid evolution of techniques for comprehensively assessing biofuel-related GHG emissions.

Finally, the regulations should require EPA to make the results of its review available to the public no later than one year after commencement of the review. This report should discuss any new data and methodologies reviewed by EPA, how they affect EPA's understanding of the lifecycle GHG emissions analysis in general and fuel specific GHG estimates, and the rationale for any changes to the RFS2 that EPA will adopt. Providing a definite deadline to make the findings of the review and any changes publicly available will ensure transparency and reduce uncertainty for stakeholders, thereby increasing the likelihood of smooth implementation of any regulatory changes.

In sum, we agree that the science of lifecycle GHG emissions analyses is evolving and that periodic review is necessary to ensure a robust, state-of-the-art assessment methodology and accurate fuel-specific GHG estimates. However, as stated above, EPA's proposal must be improved in several ways to achieve these goals.

VI. Conclusion

Once again, we are pleased to provide these comments to EPA and we look forward to working with Agency on the development and implementation of RFS2 rules that truly benefit the environment.

Respectfully submitted,

CLEAN AIR TASK FORCE

Friends of the Earth

Jonathan F. Lewis
Helen D. Silver
Clean Air Task Force
18 Tremont Street, Suite 530
Boston, MA 02108
Tel: 617.624.0234

Kate McMahon
Friends of the Earth
1717 Massachusetts Avenue NW, Suite 600
Washington, DC 20036
Tel: 202.783.7400

[128] *Id.*

APPENDIX:

Environmental Community Comments