



December 15, 2010

Honorable Mary Nichols, Chair,
California Air Resources Board

Re: Comments on the Proposed AB 32 Greenhouse Gas Cap-and-Trade Regulation

Dear Ms. Nichols and Members of the California Air Resources Board:

On behalf of our more than 315,000 members and activists, the Center for Biological Diversity submits these comments on the proposed cap-and-trade regulation. We thank the California Air Resources Board (“ARB”) staff and members for their continued efforts to reduce greenhouse pollution and implement California’s Global Warming Solutions Law (AB 32). Despite these diligent efforts, however, the rule package before ARB contains significant flaws, especially with respect to the Forest Offset Protocol and the exemption from compliance obligations for sources of biomass and biofuels combustion emissions. The Functional Equivalent Document (“FED”) containing ARB’s analysis of the environmental impacts of the proposed regulation also fails to disclose, analyze, and propose mitigation for significant environmental impacts, and fails to adequately discuss a range of reasonable alternatives that could avoid these impacts. As discussed below, these problems reduce the effectiveness and integrity of the proposed rule. With the science showing ever more clearly with each passing day the urgent need for deep and rapid greenhouse pollution reductions, it is essential that CARB ensure that the cap-and-trade program will successfully achieve its central purpose of producing real, additional, and permanent greenhouse gas cuts consistent with AB 32’s mandate. We urge you to correct the flaws discussed below which undercut that central purpose.¹

I. Specific Provisions of the Proposed Regulation Should Be Revised.

A. Flaws in the Forest Offset Protocol Must Be Corrected.

1. The Forest Offset Protocol should not include forest clearcutting as an eligible forest project type.

The inclusion of forest clearcutting as an eligible management type in carbon offset projects undermines the integrity of the Forest Offset Protocol and the cap-and-trade program as whole. Forest clearcutting and the conversion of native forests to tree plantations increase the

¹ PDF files containing references and exhibits cited herein have been uploaded to the ARB website separately. We have not included copies of prior comment letters submitted to ARB regarding the Forest Offset Protocol because we expect that those letters are already part of the administrative record of proceedings in this matter.

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risks to forest ecosystems, water quality, and wildlife habitat, and can impair the forest's resilience to the impacts of climate change.²

Intensification of forestry activities is often promoted on the basis that young, actively growing trees will sequester carbon more rapidly than old-growth forests in which respiration may equal or even exceed photosynthesis (Birdsey 1992). Replacement of old forests with plantations is a "perverse incentive" of the Kyoto Protocol (Brown 1998; Dudley 1998). Simplistic carbon accounting, encouraged by the protocol, ignores the tremendous releases of carbon that occur when forests are disturbed by logging and related activities such as site preparation and vegetation management (Perry 1994; Schulze et al. 2000). It ignores the fate of woody debris and soil organic carbon during forest conversion (Cooper 1983; German Advisory Council on Global Change 1998). Typically, respiration from the decomposition of dead biomass in logged forests exceeds net primary production of the regrowth (Schulze et al. 2000). Considerable time is required - often hundreds of years - for regenerating forests to accumulate the carbon stocks characteristic of primary forests (Harmon et al. 1990). Over several rotations of growth and harvest, the mean carbon pool of intensively managed forests is only about 30% that of primary forests (Cooper 1983). From the standpoint of maintaining biodiversity during climate change, conversion of natural forests to plantations cannot be justified. Tree plantations around the world, especially exotic monocultures, have less biodiversity than natural forests in the same regions (Hunter 1990; Noss & Cooperrider 1994; Perry 1994). Plantations are often markedly less resistant to disturbances such as fire and more subject to pest outbreaks than natural forests (Schowalter 1989; Perry 1994). Pest outbreaks could increase in severity or change in distribution with changing climate (Williams & Liebhold 1995), amplifying the vulnerability of plantations.³

The habitat fragmentation caused by forest clearcutting can have a substantial negative impact on forest resilience and climate adaptation.

Fragmentation may threaten biodiversity during climate change through several mechanisms, most notably edge effects and isolation of habitat patches. Intact forests maintain a microclimate that is often appreciably different from that in large openings. When a forest is fragmented by logging or other disturbance, sunlight and wind penetrate from forest edges and create strong microclimatic gradients up to several hundred meters wide, although they may vary in severity and depth among regions and forest types (Ranney et al. 1981; Franklin & Forman 1987; Chen & Franklin 1990; Laurance 1991, 2000; Chen et al. 1992; Baker & Dillon 2000). With progressive fragmentation of a

² Reed F. Noss, *Beyond Kyoto: Forest Management in a Time of Rapid Climate Change*, 15 CONSERVATION BIOLOGY 578 (2001) (attached as Ex. 1); D.P. Turner, et al., *A carbon budget for forests of the conterminous United States*, 5 ECOLOGICAL APPLICATIONS 421 (1995) (attached as Ex. 2); Mark E. Harmon, et al., *Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests*, 247 SCIENCE 699 (1990) (attached as Ex. 3).

³ Noss 2001.

landscape, the ratio of edge to interior habitat increases, until the inertia characteristic of mature forests is broken. Fragmented forests will likely demonstrate less resistance and resilience to climate change than intact forests. Another potentially serious impact of fragmentation is its likely effect on species migration. By increasing the isolation of habitats, fragmentation is expected to interfere with the ability of species to track shifting climatic conditions over space and time. Weedy species, including many exotics, with high dispersal capacities may prosper under such conditions, whereas species with poor mobility or sensitive to dispersal barriers will fare poorly.⁴

Natural forests are more resilient to climate change and disturbances than plantations because of their genetic, taxonomic and functional biodiversity. This resilience includes regeneration after fire, resistance to and recovery from pests and diseases and adaptation to changes in radiation, temperature and water availability. Regrowth forests and plantations have reduced genetic diversity and structural complexity, and therefore reduced resilience to pests, diseases and changing climate conditions (Hooper and Vitousek 1997; Hooper et al. 2005, McCann 2007).⁵

In addition, forest clearcutting and the conversion of natural forests to even-aged plantations can result in tremendous GHG emissions. For example, the conversion to plantations of over 12 million acres of old-growth forests in western Oregon and Washington in the past 100 years has resulted in the release of 1.5 to 1.8 billion metric tons of carbon into the atmosphere.⁶ However, the GHG emissions associated with the conversion of natural forests to even-aged plantations would not necessarily be counted under the forest protocol if the project is registered more than 10 years after the conversion occurs. Furthermore, the forest protocol fails to require forest projects to account for changes in the soil carbon and woody debris carbon pools, which can result in substantial GHG emissions due to the impacts of forest clearcutting.

Over half of the carbon stored in United States forests is in the forest floor and soils.⁷ The carbon stored in forest soils includes two pools: mineral soils and soil organic matter. Much of the carbon stored in mineral soils is considered to be quite stable, and does not generally change dramatically in response to land management activities such as logging, but the carbon contained in soil organic matter (which supports vegetation growth) can change substantially in response to harvest activities and can be significantly reduced through forest clearcutting and associated soil disturbance activities, such as deep-ripping.⁸

⁴ Noss 2001.

⁵ Brendan Mackey, et al., *Green carbon: the role of natural forests in carbon storage. Part 1, A green carbon account of Australia's south-eastern Eucalypt forest, and policy implications*, The Fenner School of Environment & Society, The Australian National University (2008) (attached as Ex. 4).

⁶ Harmon et al. 1990.

⁷ Turner et al. 1995

⁸ Robert Jandl, et al., *How Strongly Can Forest Management Influence Soil Carbon Sequestration?*, 137 *GEODERMA* 253 (2007) (attached as Ex. 5); R. Birdsey and L. S. Heath,

Clearcutting can also significantly impact the woody debris carbon pool:

Woody detritus also plays an important role in controlling carbon dynamics of forests during succession. Along with live woody parts of trees, dead wood or woody detritus is a large pool undergoing a relatively large change in stores during succession.⁹

When ARB adopted the Forest Project Protocol, version 3.0, in September 2009, staff assured board members at that time that the issues associated with the inclusion of forest clearcutting would be addressed before the Forest Offset Protocol would be proposed for use in the cap-and-trade program.¹⁰ Since September 2009, the Climate Action Reserve has made some changes to its Forest Project Protocol, but it has failed to address these issues. The Forest Offset Protocol now proposed in the cap-and-trade regulation is nearly identical to the most recent Forest Project Protocol prepared by the Climate Action Reserve, with no substantive changes to the provisions related to forest clearcutting.

The inclusion of forest clearcutting as an eligible project type under the Forest Offset Protocol proposed in the cap-and-trade rule directly contradicts AB 32's requirement to maximize the environmental benefits from a carbon market program. In order to protect against some of the worst possible unintended consequences and negative environmental impacts, the Forest Offset Protocol should explicitly prohibit forest carbon offset projects that include even-aged management

Carbon Changes in U. S. Forests, in PRODUCTIVITY OF AMERICA'S FORESTS AND CLIMATE CHANGE (GTR-RM-271), edited by L. A. Joyce: USDA Forest Service, Rocky Mountain Research Station (1995) (attached as Ex. 6); Harmon et. al. 1990.

⁹ Mark E. Harmon, 2009, *Woody Detritus Mass and its Contribution to Carbon Dynamics of Old-Growth Forests: the Temporal Context*, in C. Wirth et al. (eds.), OLD-GROWTH FORESTS, Ecological Studies 207 (2009) (attached as Ex. 7).

¹⁰ "It is important to note that the forest protocol does not establish rules for compliance markets, trading, or offsets. Board adoption of the methodologies within the updated protocol will encourage early action greenhouse gas reduction projects while the compliance market in California's cap and trade program is developed." Erik Winegar, ARB, at the September 24, 2009 ARB board meeting. At that same board meeting Board member D'Adamo asked: "[C]an we at a later point... [as] part of our adoption of cap and trade, insist on a higher standard for forestry or whatever industry the protocols apply to?" ARB Lynn Terry answered: "[W]e wanted to be very clear that this is protocol for voluntary actions and that the Board's approval today is restricted to that arena and that for purposes of cap and trade, the Board will consider the rules of the game in terms of offsets that may be brought into the system. And so, yes, those kinds of criteria will be developed going forward as part of the cap and trade rule development process." Emphasis in underline added.

2. Flaws in the Forest Offset Protocol threaten to undermine the value, additionality, and verifiability of forest offset credits.

The Forest Offset Protocol proposed in the cap-and-trade regulation is nearly identical to the Forest Project Protocol prepared by the Climate Action Reserve. For example, as previously discussed, the Forest Offset Protocol continues to allow and incentivize even-aged management practices such as clearcutting that imperil forest health, water quality, and biodiversity; continues to provide incentives for conversion of native forests to plantations; continues to contain loopholes that incentivize increased short-term logging (and associated GHG emissions); and continues to offer credits for non-additional forest management activities in a manner that could increase overall GHG emissions. The impacts associated with these incentives and loopholes have been detailed in a series of letters from the Center to both the Climate Action Reserve and ARB over the past year.¹¹ The FED largely fails to address the specific impacts identified in this series of letters. Accordingly, the arguments raised in those letters apply with equal force to the Forest Offset Protocol proposed in connection with the cap-and-trade program. These letters, which already appear in the record of ARB's proceedings in this matter, are therefore once again incorporated by reference.

ARB's own review of the forest protocol identified issues that threaten to undermine the value, additionality, and verifiability of forest offset credits.¹² These included concerns with the Forest Project Protocol's methodology for modeling additionality and baseline; treatment of lying dead wood and soil carbon; leakage; permanence; the treatment of carbon associated with wood products; and even-aged management. However, ARB has proposed no substantive changes to any provision related to these issues following that initial review.

More recently, the Climate Action Reserve adopted revisions to the forest protocol that undermine the additionality of Improved Forest Management projects. On August 31, the CAR adopted revisions to the forest protocol that explicitly exempt forest projects from having to incorporate into the project baseline any forest growth that is projected to occur under these long-term management plans. Similarly, the revision fails to clearly require actions undertaken as mitigation measures under CEQA to be included in the project baseline.¹³ The Center

¹¹ See Letter to ARB Re: CEQA Violations in Adoption of Forest Project Protocols (Nov. 9, 2009); Letter to ARB Re: Continuing CEQA Violations in Adoption of Forest Project Protocols (Jan. 11, 2010); Letter to ARB Re: Revisions to the Forest Project Protocol (Aug. 4, 2010); Letter to ARB Re: Review of the environmental impacts and co-benefits of an AB 32 cap-and-trade program (Sept. 10, 2010).

¹² ARB staff presentation, June 23, 2010, Transitioning to Compliance Protocols.

¹³ The June 23 presentation by ARB incorrectly identified CEQA mitigation measures as "voluntary." In fact, mitigation measures adopted pursuant to CEQA are legal requirements; in order to satisfy CEQA, mitigation measures "must be fully enforceable through permit conditions, agreements, or other legally binding instruments." Cal. Code Regs., tit. 14, § 15126.4(a)(2).

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submitted comments to both the CAR and ARB regarding this issue. These letters are therefore attached and incorporated by reference.¹⁴

In addition, the Center has submitted comments to both CAR and ARB highlighting a number of concerns regarding the integrity of the Forest Protocol.

- Forest offset projects are not prohibited from shifting timber harvesting to elsewhere in their timber operations, and are not even required to report such “leakage.”
- Forest offsets provide a much lower degree of permanence than other offset projects.
- Forest offsets carry a much greater risk of reversal than offsets from other sources.
- Sequestration in wood products is uncertain and beyond the project boundaries.

However, ARB has proposed no substantive changes in the Forest Offset Protocol that would address any of these issues. Accordingly, the arguments raised in our prior letters to ARB and CAR apply with equal force to the Forest Offset Protocol proposed in connection with the cap-and-trade program. Those letters and the arguments therein are therefore incorporated by reference.

3. ARB must evaluate the additionality of forest projects implemented as early actions.

Forest projects registered under earlier versions of the Climate Action Reserve’s Forest Project Protocol (version 2) were allowed to define the baseline as essentially the regulatory minimum for the project area. That is, under the previous versions of the protocol, the baseline was even more vulnerable than it is now to manipulation that would allow forest landowners to obtain carbon credit for forest growth that would have occurred under a business-as-usual scenario. If the credits from such projects are to be adopted for use in the cap-and-trade program, those forest projects must be evaluated for additionality. Without performing this evaluation, ARB risks adopting non-additional credits into the compliance program.

C. The Proposed Exemption for Biogenic Emissions Must Be Eliminated.

1. The ISOR fails to explain the exemption for biogenic emissions.

Among other things, an ISOR must include a “statement of the specific purpose” of each proposed regulation and “the rationale for the determination by the agency that [each proposed regulation] is reasonably necessary to carry out the purpose for which it is proposed.” Gov. Code § 11346.2(b)(1). The ISOR also must identify “each technical, theoretical, and empirical

¹⁴ See Center for Biological Diversity, Letter to Climate Action Reserve Re: Preliminary Guidance on Forest Project Protocol, Section 6.2.1.1 (Legal Requirements for Project Baseline; Supplemental Comments) (April 30, 2010) (attached as Ex. 8); Center for Biological Diversity, Letter to Climate Action Reserve Re: Comments on Proposed Amendments to Baseline Determination of the Forest Project Protocol Version 3.1 (July 30, 2010) (attached as Ex. 9).

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study, report, or similar document” on which ARB relies in proposing the regulation. Gov. Code § 11346.2(b)(2). Furthermore, the ISOR must describe “reasonable alternatives to the regulation and the agency’s reasons for rejecting those alternatives.” Gov. Code § 11346.2(b)(3).

The ISOR fails to comply with these requirements of law. Nowhere does the ISOR explain why the proposed regulation, at section 95852.2, exempts virtually all combustion emissions from biogenic sources from compliance obligations. Nor does the ISOR identify any technical, theoretical, or empirical support for the exemption. By the same token, the ISOR fails to describe any alternative approaches to the exemption or ARB’s reasons for rejecting them.

Without an understanding of ARB staff’s rationale for the exemption, neither the public nor decision-makers can assess whether it is consistent with the purpose of AB 32 or participate meaningfully in the public process surrounding adoption of the regulation. Accordingly, staff’s failure to explain the reasoning behind the exemption constitutes a substantial failure to comply with the Administrative Procedure Act. *See* Gov. Code § 11350.

2. Biomass combustion is not “carbon neutral.”

The unchecked expansion of biomass energy—particularly the use of woody biomass to generate electricity—represents a double threat to the climate and to California’s forests. Although scientists and policy-makers have now thoroughly debunked the long-standing myth that biomass combustion is “carbon neutral,” industry proponents continue to seek special treatment for biomass projects based on the dangerously false contention that biogenic GHG emissions do not affect the climate. Public incentives for biomass, embodied in renewable energy standards and other policies, are both threatening to exacerbate greenhouse pollution and putting increased pressure on the nation’s forests by increasing the demand for woody fuel. The proposed cap-and-trade regulation, with its blanket exemption for biomass and biofuels, would create another powerful incentive for biomass development in California.

Biomass combustion causes GHG emissions, particularly of CO₂. Indeed, CO₂ emissions from electrical generating units burning woody biomass rival or exceed those of coal-burning facilities, and are nearly double those of facilities burning natural gas.¹⁵ CO₂ from fossil sources shares the same physical characteristics and same climate-forcing properties as CO₂ from biogenic sources. There is no physical, chemical, or climate-forcing difference between fossil CO₂ and biogenic CO₂. Put simply, CO₂ is CO₂. Infrared radiation does not and cannot discriminate among the identical molecules of CO₂ circulating in the atmosphere.

There is thus no basis in law, science, or sound policy for exempting sources of biogenic GHG emissions from compliance obligations. These emissions affect California’s ability to achieve AB 32’s objectives just as much as emissions from other sources. Moreover, the climate

¹⁵ *See, e.g.,* Manomet Center for Conservation Sciences, *Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources* (2010) at 129 (attached as Ex. 10).

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impacts of any particular biomass facility will vary greatly, depending on fuel characteristics and sources, secondary emissions associated with harvesting and processing, land use impacts, and effects on future sequestration. In effect, the degree to which a particular biomass project might plausibly claim to be “carbon neutral,” and the time it might take to achieve neutrality, cannot be known absent a complete lifecycle analysis considering all of these factors and variables. It is this type of analysis—not an unexplained and unsupported blanket exemption for biomass emissions—that ARB should be developing as part of this regulation.

Neither the ISOR nor the FED offers any insight into why the proposed regulation exempts biomass emissions from compliance obligations. The obvious implication from this silence is that ARB staff views biomass combustion as “carbon neutral,” although neither document explains the theory behind this belief. Whatever the theory, this view is not supported by the facts.

Biogenic Emissions Are Not Automatically Carbon-Neutral.

Some biomass proponents claim that all biogenic GHG emissions are part of a “natural” carbon cycle that by definition cannot have any effect on the climate. Under this theory, burning biomass releases carbon that was removed from the atmosphere by the fuels as they were growing, and thus completes a “natural” cycle by returning that carbon to the atmosphere.

This theory is facially—and dangerously—incorrect. Taken to its logical conclusion, this theory would hold that deforestation has no effect on climate change. Indeed, under a literal application of this theory, every single tree, shrub, and blade of grass on Earth could be burned tomorrow and converted into CO₂ with no discernible effect on the climate.

Scientists and policy-makers agree, however, that deforestation—which necessarily entails conversion of sequestered biogenic carbon into atmospheric CO₂—does contribute to climate change. Ten to 15 percent of global carbon emissions result from deforestation and forest degradation, primarily in the tropics.¹⁶ These emissions are estimated at between 1,400 and 2,000 Tg per year.¹⁷ Although U.S. forests are generally considered a net carbon sink, this may be true only due to significant global leakage related to domestic demand for wood and

¹⁶ See Gregory P. Asner, et al., *High-Resolution Forest Carbon Stocks and Emissions in the Amazon*, PROC. NAT’L ACADEMY OF SCI. EARLY EDITION, available at <http://www.pnas.org/content/early/2010/08/30/1004875107> (last visited Dec. 15, 2010) (attached as Ex. 11).

¹⁷ Michael G. Ryan, et al., *A Synthesis of the Science on Forests and Carbon for U.S. Forests*, Ecological Society of America: Issues in Ecology, Report No. 13 (Spring 2010) at 5 (attached as Ex. 12).

agricultural products.¹⁸ GHG emissions associated with these losses are significant contributors to climate change notwithstanding their “biogenic” character.¹⁹

The “natural carbon cycle” theory also ignores the fact that a tremendous amount of primary forest, representing a huge proportion of historic biogenic carbon stores, has been lost during the last few centuries. According to recent maps compiled by the World Resources Institute, only 21 percent of the world’s forests are “intact,” and 47 percent have been lost entirely.²⁰ Between 1850 and 2000, global land use change caused emissions of 156,000 Tg of carbon, mostly from deforestation.²¹ Recent studies indicate that the density of remaining forest cover may be lower and far more variable than previously thought.²² The United States has also experienced the greatest loss of forest cover, as a proportion of forest cover in the year 2000, of any country with more than one million square kilometers of forest.²³ This historic and continuing loss of forest biomass—much of which has been burned or otherwise converted into atmospheric carbon pollution—represents a tremendous existing carbon debt, one that further emissions of biogenic carbon can only increase. To extend the metaphor, continuing to burn trees for energy isn’t like balancing a checkbook. It’s like taking out another mortgage on a house that’s already far underwater.

Furthermore, it makes no sense to assume that all currently existing trees and other plants are composed solely of “biogenic” carbon. More than two centuries of increasing fossil GHG emissions have accumulated in the atmosphere. Given these pollutants’ atmospheric lifetimes, and considering the lifespan of many trees and plants, it is safe to assume that some considerable portion of this fossil carbon has been resequenced in currently existing biomass. Technically, therefore, burning that biomass may be returning *fossil* carbon to the atmosphere, again increasing the overall planetary carbon imbalance relative to pre-industrial conditions. Above all, this example demonstrates that it makes little scientific sense to divide carbon into theoretical “fossil” and “biogenic” pools for the purpose of assuming simplistically that biogenic carbon is part of some natural cycle that cannot affect the climate. Whatever natural biogenic carbon cycle existed prior to the industrial revolution has been radically altered by deforestation, land use change, and fossil carbon emissions.

¹⁸ *Id.* at 5-6.

¹⁹ See Eric Johnson, *Goodbye to Carbon Neutral: Getting Biomass Footprints Right*, 29 ENVTL. IMPACT ASSESSMENT R. 165 (2008) (attached as Ex. 13). Other studies have identified significant emissions associated with changes in land use and productivity in response to demand for biofuels. See, e.g., Jerry M. Melillo, et al., *Indirect Emissions from Biofuels: How Important?* SCIENCEEXPRESS 10.1126/science.1180251 (Oct. 22, 2009) (attached as Ex. 14).

²⁰ World Res. Inst., *State of the World’s Forests* (Jan. 8, 2009), at <http://www.wri.org/map/state-worlds-forests> (last visited Dec. 15, 2010) (attached as Ex. 15).

²¹ Ryan 2010 at 6.

²² See Asner 2010.

²³ Matthew C. Hansen, et al., *Quantification of Global Gross Forest Cover Loss*, 107 PROC. NAT’L ACADEMY OF SCI. 8650 (May 11, 2010) (attached as Ex. 16).

The extent and duration of the effects of global warming will be determined largely by the degree to which anthropogenic sources of GHGs, particularly CO₂, continue to exceed the capacity of the Earth's carbon sinks for reabsorption—in other words, by the cumulative total of anthropogenic greenhouse pollutants in the atmosphere.²⁴ Every ton of CO₂ counts toward this total, regardless of what was burned to produce it. Every ton of CO₂ similarly counts toward California's effort to meet the statutory goals of AB 32. Broad exemptions from compliance obligations for large categories of emissions facilitate near-term GHG pollution and interfere with these goals.

Biomass Combustion Creates a “Carbon Debt” that Can Last for Decades or Even Centuries.

Under another common theory advanced by proponents of biomass energy, biomass burning should be considered carbon neutral because any GHG emissions will be reabsorbed by future plant growth that replaces the harvested fuel. Yet carbon emitted during biomass combustion may remain in the atmosphere for decades or centuries before being resequenced.

Another version of this theory assumes that the emissions from present combustion and future decomposition are roughly the same, and thus concludes that combustion has a “net zero” emissions profile. ARB staff articulated this theory, albeit in a conclusory and unsupported fashion, in the ISOR for the Renewable Electricity Standard.²⁵

Both versions of the theory ignore the critical temporal relationships between present carbon emissions and the future effects of global warming and climate change. In other words, because meeting (or exceeding) atmospheric CO₂ targets has a strong temporal element, the time that it takes for CO₂ released into the atmosphere today to be reabsorbed is of critical importance in assessing the climate impacts of carbon emissions. By the same token, the carbon in living and dead biomass will remain sequestered in various pools (including forest soils) for a significant amount of time, whereas combustion immediately converts all of that carbon to atmospheric GHGs.²⁶ This time lag has been identified in several recent studies as the source of

²⁴ See COMMITTEE ON STABILIZATION TARGETS FOR ATMOSPHERIC GREENHOUSE GAS CONCENTRATIONS; NATIONAL RESEARCH COUNCIL, STABILIZATION TARGETS FOR ATMOSPHERIC GREENHOUSE GAS CONCENTRATIONS (National Academies Press 2010) at 15 (“NRC Report”), available at http://www.nap.edu/catalog.php?record_id=12877 (last visited Dec. 15, 2010) (prepublication excerpts attached as Ex. 17).

²⁵ Cal. Air Res. Bd., Proposed Regulation for a California Renewable Electricity Standard, Staff Report: Initial Statement of Reasons (June 2010) at IX-4.

²⁶ See, e.g., Anna Repo, et al., *Indirect Carbon Dioxide Emissions from Producing Bioenergy from Forest Harvest Residues*, GLOBAL CHANGE BIOLOGY BIOENERGY (2010) (attached as Ex. 18); Alexander Gershenson et al., *Accounting for Carbon in Soils*, Climate Action Reserve White Paper (2010) (“Soil carbon losses can be minimized where retention of post-logging debris on site is maximized”) (attached as Ex. 19).

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a “carbon debt” that varies by fuel source, technology, and comparison to the fossil fuels assumed to be displaced by bioenergy generation.²⁷

The biomass carbon debt is especially pronounced when trees are burned for energy. Scientists agree that “[t]he amount of carbon sequestered by forest ecosystems plays an important role in regulating atmospheric levels of carbon dioxide.”²⁸ The removal and processing of forest biomass reduces storage in forest carbon pools and results in short-term emissions of greenhouse gases, even when some of that biomass remains sequestered for a period of time in commercial forest products.²⁹ According to recent studies, “[t]ypically 30–50% of the harvested C is lost in manufacturing and initial use, a loss that is larger than could be expected from even the most extreme forest fire.”³⁰ Where harvested biomass is combusted for energy, rather than processed into wood products, short-term emissions are necessarily far greater, and long-term sequestration in forest products is eliminated altogether.

In addition to converting woody biomass into CO₂, thinning and post-fire salvage operations for bioenergy production also reduce the future carbon sequestration potential of the affected forest stand by removing trees that otherwise would have continued to draw CO₂ from the atmosphere.³¹ Surveys of the world’s most carbon-dense forests, including the moist temperate conifer forests of North America, have confirmed that the greatest accumulations of biological carbon occur in the absence of human land-use disturbance.³²

²⁷ See, e.g., Manomet Report (2010) at 7. Subsequent researchers have concluded that the assumptions in the Manomet Report are excessively generous toward biomass and that bioenergy emissions (and resulting carbon debts) may be larger than the study estimated. Mary S. Booth, Review of the Manomet Biomass Sustainability and Carbon Policy Study (July 2010) (attached as Ex. 20).

²⁸ Tara Hudiburg, et al., *Carbon Dynamics of Oregon and Northern California Forests and Potential Land-Based Carbon Storage*, 19 *ECOLOGICAL APPLICATIONS* 163, 163 (2009) (attached as Ex. 21).

²⁹ See *id.* at 176-77 (discussing carbon storage reductions associated with shorter rotations and emissions caused by logging).

³⁰ Mark E. Harmon, et al., *Effects of Partial Harvest on the Carbon Stores in Douglas-fir/Western Hemlock Forests: A Simulation Study*, 12 *ECOSYSTEMS* 777, 778 (2009) (attached as Ex. 22).

³¹ See Brooks M. Depro, et al., *Public Land, Timber Harvests, and Climate Mitigation: Quantifying Carbon Sequestration Potential on U.S. Public Timberlands*, 255 *FOREST ECOLOGY & MGMT.* 1122 (2008) (attached as Ex. 23) (concluding that eliminating timber harvest on public lands would increase forest carbon storage capacity by roughly 40-50% over “business as usual”).

³² See Heather Keith, et al., *Re-evaluation of Forest Biomass Carbon Stocks and Lessons from the World’s Most Carbon-Dense Forests*, 106 *PROC. NAT’L ACADEMY OF SCI.* 11,635 (2009) (attached as Ex. 24).

Removal of forest biomass also affects long-term carbon storage in forest soils. Thinning and harvesting operations can reduce carbon inputs to soils and stimulate soil respiration, resulting in both reduced soil sequestration and near-term emissions.³³ A recent meta-analysis of logging impacts in temperate forests showed that harvesting reduced soil carbon by an average of eight percent; depending on soil type, forest composition, and harvest method, some losses were as high as 36 percent.³⁴ Other studies have shown that forests remain net sources of carbon emissions for more than a decade after logging operations, primarily due to increased soil respiration.³⁵ Fuel treatments that change the amount and composition of decomposing forest biomass can influence long-term below-ground carbon storage.³⁶

The time between harvest and complete reabsorption of all this lost carbon by a forest stand—the duration of the “carbon debt”—can span decades or even centuries.³⁷ For example, one recent study concluded that even assuming perfect conversion of biomass to energy and a one-to-one displacement of fossil-fired generation, it still took from 34 to 228 years for forests in the western U.S. to reach carbon neutrality for biomass used directly for energy generation, and between 201 and 459 years if the biomass was converted to biofuels (the ranges depending upon the characteristics of the trees, forests and fire return intervals).³⁸ Accordingly, because forest biomass utilization is not carbon neutral in the near term, the near-term effects of carbon emissions associated with biomass combustion must be considered.

This is especially important here because the primary goal of AB 32—reducing California’s GHG emissions to 1990 levels by 2020—is a near-term goal. Accordingly, excessive near-term emissions will likely impede achievement of this goal. Moreover, at a global level, near-term GHG emissions exacerbate the risk of increasing atmospheric concentrations of greenhouse pollutants to the point where severe impacts are unavoidable—the so-called climate “tipping point.” It is well established as a matter of science and policy that in order to avoid the worst impacts of global warming and climate change, global temperatures must not be allowed to exceed 2°C over pre-industrial levels.³⁹ Whether we exceed the 2°C

³³ Jandl (2007) at 257-58.

³⁴ Lucas E. Nave, et al., *Harvest Impacts on Soil Carbon Storage in Temperate Forests*, 259 *FOREST ECOLOGY & MGMT.* 857 (2010) (attached as Ex. 25).

³⁵ Jandl 2007 at 258.

³⁶ Stephen R. Mitchell, et al., *Forest Fuel Reduction Alters Fire Severity and Long-Term Carbon Storage in Three Pacific Northwest Ecosystems*, 19 *ECOLOGICAL APPLICATIONS* 643, 652 (2009) (attached as Ex. 26); *see also* CHAD HANSON, *THE MYTH OF “CATASTROPHIC” WILDFIRE: A NEW ECOLOGICAL PARADIGM OF FOREST HEALTH* (2010) (attached as Ex. 27).

³⁷ *See* Giuliana Zanchi et al., *The Upfront Carbon Debt of Bioenergy* (May 2010) at 16 (attached as Ex. 28).

³⁸ Mitchell 2009 at 651.

³⁹ James Hansen, et al., *Target Atmospheric CO₂: Where Should Humanity Aim?*, 2 *OPEN ATMOS. SCI. J.* 217 (2008) (attached as Ex. 29). Even the 2°C target may be inadequate to prevent serious impacts. Recognizing this fact, the Alliance of Small Island States—a group of island nations whose very existence is threatened by climate change-related sea level rise—has

threshold depends on the level at which atmospheric CO₂ levels are eventually stabilized, which in turn depends on total cumulative anthropogenic GHG emissions. The greater the CO₂ levels, the greater the risk of exceeding this threshold and triggering likely catastrophic climate changes. The probability of overshooting 2°C is as follows according to Hare and Meinshausen (2006):

85% (68-99%) at 550 ppm CO₂ eq (= 475 ppm CO₂)
47% (26-76%) at 450 ppm CO₂ eq (=400 ppm CO₂)
27% (2-57%) at 400 ppm CO₂ eq (= 350 ppm CO₂)
8% (0-31%) at 350 ppm CO₂ eq⁴⁰

According to these scientists, “[o]nly scenarios that aim at stabilization levels at or below 400 ppm CO₂ equivalence (~350 ppm CO₂) can limit the probability of exceeding 2°C to reasonable levels.”⁴¹ But in order to achieve stabilization levels that avert the worst impacts of climate change, emissions must peak by about 2015, and must decline very rapidly thereafter.⁴²

In short, minimizing CO₂ emissions in the *next few years* is critically important to meeting both AB 32’s goals and global climate targets, even if some of all of that CO₂ might in theory be reabsorbed from the atmosphere in the decades or centuries to come. The science makes clear that the time frame for resequestration of CO₂ emitted from forest biomass combustion is on the order of decades or centuries, not years. Indeed, in evaluating carbon emissions from other biofuels, independent scientists have begun to develop strategies for evaluating the carbon impacts of biofuels in relation to the high social and environmental cost of short-term emissions.⁴³ Even EPA has begun to recognize the importance of this temporal analysis in other contexts.⁴⁴ Short-term CO₂ emissions from woody biomass combustion are

declared that average global temperature increases must be limited to “well below 1.5°C above pre-industrial levels.” Alliance of Small Island States, *Declaration on Climate Change 2009* (Sept. 21, 2009) (attached as Ex. 30).

⁴⁰ B. Hare & M. Meinshausen, *How Much Warming Are We Committed To and How Much Can Be Avoided?*, 75 CLIMATIC CHANGE 111 (2006) (attached as Ex. 31).

⁴¹ *Id.* at 137.

⁴² See IAN ALLISON, ET AL., THE COPENHAGEN DIAGNOSIS: UPDATING THE WORLD ON THE LATEST CLIMATE SCIENCE 9 (2009) (attached as Ex. 32); see also NRC Report (2010) at 46-57; M. den Elzen & N. Höhne, *Reductions of Greenhouse Gas Emissions in Annex I and Non-Annex I Countries for Meeting Concentration Stabilisation Targets*, 91 CLIMATIC CHANGE 249 (2008) (attached as Ex. 33).

⁴³ See M. O’Hare et al., *Proper Accounting for Time Increases Crop-Based Biofuels’ Greenhouse Gas Deficit Versus Petroleum*, 4 ENVTL. RESEARCH LETT. 024001 (2009) (attached as Ex. 34) (applying discount rate to account for importance of early emissions).

⁴⁴ See U.S. EPA, *EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels* (2009) (attached as Ex. 35) (“[T]he time horizon over which emissions are analyzed and the application of a discount rate to value near-term versus longer-term emissions are critical factors”).

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thus *significant*—not “neutral”—in the context of efforts to avoid the worst impacts of climate change, and should be treated as such for purposes of AB 32 as well.

Even if regeneration of a biomass fuel may one day repay the carbon debt incurred when it was first burned, the greenhouse pollution emitted upon combustion will act to warm the atmosphere for years, decades, or centuries in the meantime. Put another way, even if a particular biomass fuel may one day arguably become *carbon* neutral, its emissions are not *climate* neutral in the interim. Rather, they exert a warming effect on the climate and contribute to the total cumulative accumulation of GHGs in the atmosphere that will determine not only California’s success or failure in meeting the goals of AB 32, but also humanity’s success or failure in heading off the worst impacts of climate change.

National-Level Reporting and Inventory Programs Provide No Basis for Exemptions at the Facility Scale.

Industry proponents also often claim that counting and regulating biomass emissions at the facility level would contradict GHG reporting and inventory methodologies adopted by the Intergovernmental Panel on Climate Change (“IPCC”) and Environmental Protection Agency, both of which treat biomass emissions as carbon neutral.

Scientists, however, have called into question whether biomass emissions should be considered carbon neutral even at the national inventory scale. As explained in a recent Environmental Working Group report,

The “accounting error” that assumes carbon neutrality for biomass power is based on a misreading of internationally accepted carbon accounting standards promulgated by the Intergovernmental Panel on Climate Change (IPCC). These rules count any harvesting of wood as a direct and immediate emission of carbon dioxide to the atmosphere *at the time of harvesting*. These emissions are only considered to be re-sequestered following the slow, often multi-decade regrowth of cut forests. Emissions released when biomass power plants actually burn this fuel are *not* counted under IPCC rules in order to avoid double counting.

The U.S. Environmental Protection Agency (EPA) and other institutions that track carbon emissions have misinterpreted this accounting rule. The EPA does not count stack emissions when biomass is burned for power generation, but it also does not account for emissions at the time of harvesting. *The result is that emissions from biomass power are never counted.*⁴⁵

As one leading scientist put it, EPA and IPCC accounting “erroneously treats all bioenergy as carbon neutral regardless of the source of the biomass, which may cause large

⁴⁵ MARY S. BOOTH AND RICHARD WILES, CLEARCUT DISASTER: CARBON LOOPHOLE THREATENS U.S. FORESTS (Environmental Working Group 2010) at 12 (emphasis in original) (attached as Ex. 36).

differences in net emissions. For example, the clearing of long-established forests to burn wood or grow energy crops is counted as a 100% reduction in energy emissions despite causing large releases of carbon.”⁴⁶ Energy generated from biomass thus reduces greenhouse gas emissions “only if the growth and harvesting of the biomass for energy captures carbon above and beyond what would be sequestered anyway.”⁴⁷ Accordingly, the better solution is to focus first on carbon emissions from the smokestack, and then to factor in emissions and reductions associated with land use change and other relevant considerations. Compliance obligations for biomass emissions under the cap-and-trade program—which measure emissions first and foremost at the stack—are consistent with this good accounting practice.

Biomass and Biofuels Emissions Do Not Necessarily Displace Fossil Fuel Emissions.

Another common assumption of carbon neutrality proponents is that biomass and biofuels combustion by definition displaces fossil-fuel combustion. In other words, this carbon neutrality theory hinges on the belief that for each ton of biomass burned, an equivalent amount of fossil fuel is not burned, and any resulting fossil GHG emissions are therefore completely avoided.

Like other assumptions underlying the carbon neutrality argument, this assumption lacks a sound basis in fact. First, the assumption of one-to-one displacement does not account for growth in demand for energy or other products, but rather seems to assume a flat demand curve. Population and economic growth, however, will generally cause increases in demand, even as energy use and manufacturing become more efficient.⁴⁸ As a result, biomass may simply be adding capacity rather than displacing capacity currently satisfied by fossil fuels.

Second, in the energy sector, it cannot be assumed that future demand will automatically be satisfied by fossil-fired, carbon-intensive generation. Rightly or wrongly, biomass energy is widely considered to be renewable energy, and thus competes with other renewables for subsidies, incentives, and market share within renewable portfolio standards and renewable electricity standards. Accordingly, to the extent that biomass generation adds capacity to serve future demand in the context of a renewable energy standard, it may well displace other renewables (such as wind and solar, which tend to be more expensive per unit of energy

⁴⁶ Timothy Searchinger, et al., *Fixing a Critical Climate Accounting Error*, 326 SCIENCE 527, 527 (2009) (attached as Ex. 37). As described above, this error is not limited to situations where forests are cleared entirely or converted to energy crops or other uses; rather, this error also infects analysis of the carbon impacts of thinning existing forests for biomass fuels, because thinning both removes stored carbon and can slow the rate and amount of future potential sequestration.

⁴⁷ *Id.* at 528.

⁴⁸ Demand in California, for example, is expected to continue to grow, even under current economic conditions. See Cal. Energy Comm’n, California Energy Demand 2010-2020: Adopted Forecast, Report No. CEC-200-2009-012-CMF (Dec. 2009) (Executive Summary attached as Ex. 38).

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generated) rather than fossil fuels, resulting in dramatically increased carbon emissions per megawatt of energy produced.⁴⁹ Determining whether and to what extent biomass generation replaces fossil-fired generation thus requires a facility-specific analysis of energy market characteristics and conditions. It cannot simply be assumed that every ton of biogenic carbon replaces a ton of fossil carbon that would otherwise enter the atmosphere.

Renewability and Sustainability Standards Do Not Necessarily Provide Good Proxies for Climate Analysis.

For the most part, existing sustainability and renewability standards exist primarily to incentivize particular forms of energy generation, and are not good proxies for analysis of the carbon footprint of a particular biomass-burning facility. These standards thus typically reflect political and economic rather than primarily scientific or technology-based considerations. Such standards also may create perverse incentives that lead to other unacceptable environmental effects; as discussed in the Manomet Report and elsewhere, increased demand for biomass fuels can result in vastly increased levels of whole-tree harvest and even large-scale conversion of natural forests to energy crops.⁵⁰ Moreover, existing sustainability standards tend to ignore critically relevant time-scale and carbon debt questions; as previously discussed, a biomass harvesting regime that is technically “sustainable” or “renewable” on a scale of decades or centuries will still contribute significantly to climate impacts.

Limitations on “wood and wood waste” within the proposed cap-and-trade regulation, which appear to have been modeled on previous definitions of “renewable” biomass under California law, provide an excellent illustration of this problem. Combustion of wood harvested in accordance with a “timber management plan” or other “locally or nationally approved plan,” for the purpose of “forest fire fuel reduction or forest stand improvement,” would be eligible for the exemption from compliance obligations. Yet these standards say absolutely nothing about the relative carbon intensity of the fuels or the relative carbon debts associated with their removal, and thus do not provide an adequate proxy for analysis of “carbon neutrality.”

Furthermore, even to the extent that removal of “hazardous fuels” or insect-infested stands might be intended to prevent emissions associated with wildfire or widespread forest decay, it is not accurate to assume that removal and combustion of these fuels simply avoids identical emissions that would have occurred anyway. It is true that combustion of trees, brush, and litter in forest fires releases carbon emissions. Yet the emissions from fires may be far lower

⁴⁹ Some biomass proponents might argue that biomass generation provides reliable baseload power, while renewable energy from solar and wind generation is intermittent. Yet even existing biomass plants do not run reliably, and are vulnerable to complete and unexpected shutdowns, due to fluctuations in fuel supply and energy prices. See, e.g., Sierra Pacific Indus., Media Release, *Sierra Pacific Industries to Close its Loyalton, CA Power Plant* (Aug. 20, 2010) (attached as Ex. 39). Moreover, as cost-effective storage technologies continue to develop, solar and wind energy may become more competitive with baseload generation.

⁵⁰ See, e.g., Manomet Report (2010) at 8; Marshall Wise, et al., *Implications of Limiting CO₂ Concentrations for Land Use and Energy*, 324 SCIENCE 1183 (2009) (attached as Ex. 40)..

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(and far fewer live trees may be killed) than previously believed, depending upon forest type and fire intensity.⁵¹ Indeed, significant amounts of carbon remain sequestered in forest pools following even high-intensity wildfires.⁵² Carbon lost in fires also may rapidly be resequenced by early successional species following disturbance.⁵³

In fact, recent scientific studies call into question the entire enterprise of removing (and burning) biomass in order to avoid carbon emissions associated with wildfire:

[F]uel removal almost always reduces C storage more than the additional C that a stand is able to store when made more resistant to wildfire. Leaves and leaf litter can and do have the majority of their biomass consumed in a high-severity wildfire, but most of the C stored in forest biomass (stem wood, branches, coarse woody debris) remains unconsumed even by high-severity wildfires. For this reason, it is inefficient to remove large amounts of biomass to reduce the fraction by which other biomass components are consumed via combustion.⁵⁴

Accordingly, it is not accurate to assume that the carbon emissions associated with biomass energy production would have occurred in the forest anyway, on the same time scales and to the same degree, as a result of fire.⁵⁵ In reality, biomass combustion ensures that forest biomass is converted into carbon dioxide on a very short time scale, whether or not similar emissions would have occurred as a result of fire, and regardless of whether logging is as effective as natural succession in facilitating sequestration of those emissions. Current scientific work also indicates that fire, even the high-intensity variety, is a natural event that we should accept and encourage, not attempt to forestall through speculative, intensive, and destructive logging projects aimed at “forest cleaning” or “fuel reduction.”⁵⁶ The dead trees left standing after a high-intensity fire provide critical wildlife habitat as well as soil nutrients that encourage rapid growth of early successional species. Moreover, unlike emissions produced in biomass energy facilities, carbon in standing dead trees and forest floor pools may remain sequestered for a long time following even a high-intensity fire, and decays slowly into the atmosphere even as new plant growth recolonizes a burned area.

⁵¹ See, e.g., Garrett W. Meigs, et al., *Forest Fire Impacts on Carbon Uptake, Storage, and Emission: The Role of Burn Severity in the Eastern Cascades, Oregon*, 12 ECOSYSTEMS 1246 (2009) (attached as Ex. 41).

⁵² *Id.*

⁵³ See *id.* at 1260-61.

⁵⁴ Mitchell (2009) at 652.

⁵⁵ As one researcher has pointed out, the effective use of fuel treatments to avoid potential wildfire emissions would require foreknowledge of exactly where and when forest fires will occur. Garrett W. Meigs and John L. Campbell, *Comment on “Prescribed Fire As a Means of Reducing Forest Carbon Emissions in the Western United States”* 44 ENVTL. SCI. & TECH. 6250 (2010) (prepublication version attached as Ex. 42).

⁵⁶ See generally Hanson (2010).

3. ARB must close the biomass loophole by including bioenergy emissions under the cap and accounting for the greenhouse gas emissions associated with biomass production and combustion.

The cap-and-trade rule should include the GHG emissions from the combustion of biomass (in particular, forest biomass) under the cap and require covered entities to obtain allowances for the emissions associated with the production and combustion of this material.

Section 95852.2 exempts a number of fuel source categories from compliance obligations. Exempted categories include direct combustion of several sources of cellulosic biomass, including solid waste, construction and manufacturing debris, mill residues, range land maintenance residues, all agricultural crops or waste, and wood or wood waste. Covered entities must report emissions from the combustion of these fuels but are not required to obtain allowances for those emissions. Furthermore, neither users nor suppliers of biomass for energy are required to identify the sources of biomass material or report the biological greenhouse gas impacts associated with the removal of biomass for energy or fuel.

As explained in the preceding section, ARB has not explicitly made a determination regarding the overall carbon impacts of these fuel sources and does not provide any explicit explanation for the exemption. However, exempting these categories from compliance obligations is equivalent to assuming an identical flux of carbon into and out of the atmosphere associated with all biomass growth, harvest, production, and combustion.

Accordingly, emissions from bioenergy produced through combustion of biomass-derived fuels—including especially forest biomass, and “wood and wood wastes” identified in section 95852.2(a)(4)—should, as a default matter, be included under the cap and generate compliance obligations. Entities combusting these fuels should be excused from compliance obligations only to the extent that they can demonstrate that the production and use of the biomass fuel resulted in reduced or avoided greenhouse gas emissions over a timeframe relevant to AB 32, that is, by 2020.

4. ARB must close the biofuels loophole by requiring fuel providers to hold allowances to cover the greenhouse gas emissions released as a consequence of the use of transportation biofuels.

The cap-and-trade rule should include the GHG emissions from the combustion of transportation biofuels under the cap and require covered entities to obtain allowances for the emissions associated with the production and combustion of this material. It is well understood that CO₂ emissions as a result of using ethanol varies dramatically depending on how the ethanol is produced. This is also the case for other types of biofuels.

We also note that under Section 95852.2, biodiesel and ethanol are the only biofuels addressed in the proposed regulation. Other types of biofuels already commercialized or soon to be commercialized – such as (non-esterified) renewable diesel and biobutanol, etc. – are not

addressed by the proposed regulation. We further note that, under Sections 95852.2 (b) and (c) all “biodiesel” and “fuel ethanol” are fully exempt from compliance obligations. Ethanol made from cellulosic materials, corn starch or sugar cane are all treated as “zero” emissions even though it is well understood that ethanol from these different sources result in dramatically different impacts on GHG emissions. The same is true for biodiesel derived from virgin oils, tallow, or waste oils. According to ARB’s own analysis, ethanol made from corn starch can actually increase the amount of carbon dioxide released into the atmosphere.⁵⁷ While ARB’s analysis shows that both biodiesel and renewable diesel derived from soybeans provide small reductions in emissions, biomass-based diesel alternatives derived from sources such as palm oil grown on former tropical forest or peatland could substantially increase emissions.⁵⁸ As a consequence, exempting all ethanol and biodiesel from carbon allowance obligations could have the perverse effect of incentivizing the greater use of ethanol and biodiesel, regardless of whether they can contribute to reduced GHG emissions or not.

In addition, ARB’s projected baseline emissions inventories do not appear to account for the expected shift from petroleum transportation fuels to biofuels in the future (see ethanol line, http://www.arb.ca.gov/cc/inventory/data/tables/2020_ghg_emissions_forecast_2010-10-28.pdf). While some of this increase may be accomplished with lower carbon biofuels, this shift would set back ARB’s efforts to achieve 2020 GHG goals unless transportation biofuels are included in cap-and-trade or the overall level of the cap is reduced to account for leakage due to expected increasing levels of transportation biofuels.

Consequently emissions from all transportation liquid fuels should be treated equally. Fuel providers should be held accountable under the cap for the carbon emissions of all biofuels. Suppliers of biofuels should be able to apply for credits for certain fuels, if at all, only by using a comprehensive and scientifically defensible emission crediting system that accurately captures the fuel’s specific carbon footprint.

D. The Proposed Regulation Fails to Maximize Environmental Co-Benefits to the Extent Feasible

⁵⁷ ARB, Carbon Intensity Lookup Table for Gasoline and Diesel, and their Fuel Substitutes, available at: http://www.arb.ca.gov/fuels/lcfs/121409lcfs_lutables.pdf; ARB, Lifecycle Analysis - Fuel Pathways, available at: <http://www.arb.ca.gov/fuels/lcfs/workgroups/workgroups.htm#pathways>.

⁵⁸ See, e.g., Timothy Searchinger, *Biofuels and the Need for Additional Carbon*, ENVIRON. RES. LETT. 5 (2010) 024007 (attached as Ex. 43); Rhett A. Butler, et al., *REDD in the Red: Palm Oil Could Undermine Carbon Payment Schemes*, 2 CONS. LETT. 67 (2009) (attached as Ex. 44); Birka Wicke, et al., *Different Palm Oil Production Systems for Energy Purposes and their Greenhouse Gas Implications*, 32 BIOMASS AND BIOENERGY 1322 (2008) (attached as Ex. 45); Holly K. Gibbs, et al., *Carbon Payback Times for Crop-Based Biofuel Expansion in the Tropics: The Effects of Changing Yield and Technology*, ENVIRON. RES. LETT. 3 (2008) 034001 (attached as Ex. 46); Tom Beer, et al., *The Greenhouse and Air Quality Emissions of Biodiesel Blends in Australia*, CSIRO Report Number KS54C/1/F2.27 (August 2007) (attached as Ex. 47).

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Prior to adopting a cap-and-trade system under AB 32, ARB must, “to the extent feasible,” maximize additional environmental benefits to California where it is appropriate to do so. Health & Saf. Code § 38570(b)(3). By using the term “feasible,” the Legislature signaled its intent to require ARB to demonstrate that all appropriate measures must be taken to maximize environmental benefits, unless those measures are shown to be impracticable.

AB 32 does not define the term “feasible.” However, that term has a specific meaning under other statutes, including the California Environmental Quality Act—a meaning of which the Legislature was presumptively aware when it enacted AB 32. “Feasible” means “capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors.” Pub. Res. Code § 21061.1. In the CEQA context, when a lead agency rejects an alternative as economically infeasible, it must support that determination with quantitative, comparative evidence that the alternative would be economically impracticable (not just more expensive). *See, e.g., Save Round Valley Alliance v. County of Inyo*, 157 Cal. App. 4th 1437, 1461-62 (2007) (holding that applicant’s inability to achieve “the same economic objectives” under a proposed alternative does not render the alternative economically infeasible); *Uphold Our Heritage v. Town of Woodside*, 147 Cal. App. 4th 587, 600 (2007) (requiring evidence that comparative marginal costs would be so great that a reasonably prudent property owner would not proceed with the project); *Preservation Action Council v. City of San Jose*, 141 Cal. App. 4th 1336, 1356-57 (2006) (holding that evidence of economic infeasibility must consist of facts, independent analysis, and meaningful detail, not just the assertions of an interested party). Nor may a lead agency conclude that mitigation measures are legally infeasible without an adequate basis. As the Supreme Court put it, “[a]n EIR that incorrectly disclaims the power and duty to mitigate identified environmental effects based on erroneous legal assumptions is not sufficient as an informative document.” *City of Marina v. Bd. of Trustees*, 39 Cal. 4th 341, 356 (2006).

The Legislature’s use of the term “feasible” in connection with environmental co-benefits thus imposes a specific burden on ARB—a burden that the ISOR and FED fail to meet. For many months, the Center and other organizations have identified specific, appropriate measures to ARB staff (such as, for example, measures to ensure that forest offset projects improve forest management rather than perpetuate environmentally destructive practices) that could enhance, and thus help maximize, environmental co-benefits. Many of those measures are discussed again throughout this letter. At no point, however, has ARB demonstrated the infeasibility, or even the inappropriateness, of any of these measures. The cap-and-trade regulation as proposed thus fails to comply with AB 32.

II. The FED Fails to Satisfy Fundamental Requirements of the California Environmental Quality Act.

The FED fails to comply with the California Environmental Quality Act (“CEQA”), Public Resources Code § 21000 et seq., and the CEQA Guidelines, title 14, California Administrative Code, § 15000 et seq. ARB’s program for adopting air quality regulations is a

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“certified regulatory program” for CEQA purposes. CEQA Guidelines § 15251(d). Accordingly, the FED must include a description of the proposed regulation, along with alternatives and mitigation measures to minimize any significant adverse effect. Pub. Res. Code § 21080.5(d)(3); *Schoen v. Dept. of Forestry*, 58 Cal. App. 4th 556, 566-67 (1997). Although ARB’s regulatory program is exempt from certain requirements generally applicable to environmental impact reports under CEQA, *see Sierra Club v. Bd. of Forestry*, 7 Cal. 4th 1215, 1229-30 (1994), the core procedural and substantive provisions of CEQA still apply. In particular, ARB may not approve a regulation if there are feasible mitigation measures or alternatives available that would lessen or avoid its significant environmental effects. *See* Pub. Res. Code §§ 21002, 21002.1(b), 21081.

As a general matter, the FED is quick to disclaim any responsibility for implementation of measures to mitigate the potentially significant economic impacts of the cap-and-trade program. The FED repeatedly states that other agencies will be responsible for implementing those measures at the project level, *see, e.g.*, FED at 130, but fails to demonstrate in each instance that ARB lacks *any* legal authority to implement mitigation at the program level. If ARB can feasibly take steps to mitigate any specific effects of this action, it must do so; it may not shift this responsibility to other agencies as a general rule. *Cf. City of Marina*, 39 Cal. 4th at 366-67.

The FED also relies as a general matter on impermissibly deferred mitigation in the form of “adaptive management.” The FED acknowledges that the cap-and-trade program may create perverse incentives and lead to potentially significant environmental impacts. Rather than proposing measures to ameliorate those impacts as CEQA requires, however, the FED states that ARB will monitor a few limited sources of information and develop “appropriate” responses if some unidentified level of impact materializes at some point in the future. *See* FED at 43-51, 311-14. “Formulation of mitigation measures should not be deferred until some future time.” CEQA Guidelines § 15126.4(a)(1)(B). If mitigation is deferred, CEQA requires a lead agency both to develop specific performance standards and to commit to specific mitigation actions that will be taken if those standards are not met. *Id.*; *see also, e.g., Gray v. County of Madera*, 167 Cal. App. 4th 1099, 1118-19 (2008); *Endangered Habitats League v. County of Orange*, 131 Cal. App. 4th 777, 793-94 (2005) (agency “goes too far” when it requires only that project proponent obtain a “report” and then comply with recommendations in the report). The FED’s promises of “adaptive management” fail to meet these standards.⁵⁹

⁵⁹ We note also the FED’s inconsistent discussion of the status of “adaptive management” as a mitigation measure. On one hand, the FED claims that “adaptive management” is not mitigation, but rather a design feature of the project. FED at 43. On the other hand, “adaptive management” is identified as “mitigation” for some of the project’s potentially significant impacts, such as those arising from the Forest Protocol. FED at 313. The FED’s approach is invalid either way. If “adaptive management” is not mitigation, then the FED has unlawfully failed to propose or evaluate any mitigation whatsoever for a number of the project’s potentially significant environmental effects. If “adaptive management” is mitigation, it is neither adequately enforceable nor permissibly deferred, and thus does not meet the standards set by CEQA. ARB

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Under the FED's "adaptive management" strategy, moreover, ARB would take unspecified "appropriate" actions *only* if future, unanticipated environmental consequences "interfere with or undermine" the objectives of the cap-and-trade program. *See* FED at 46, 47, 313. Notably, the "adaptive management" strategy does *not* commit ARB to taking "appropriate" action in the event that significant, unanticipated environmental impacts occur. The purpose of mitigation under CEQA is to reduce or avoid significant environmental impacts, not to advance the objectives of other legislative programs. Accordingly, the "adaptive management" strategy cannot be considered mitigation under CEQA because it does not respond to the impacts that CEQA was designed to avoid.

Finally, the adaptive management approach is not designed to gather the information that would enable ARB to detect, much less respond to, unanticipated environmental impacts. In the air quality context, for example, ARB proposes to monitor greenhouse gas emissions from covered sources. FED at 46-47. A major concern with the cap-and-trade program, however, is that emissions trading will result in increased local concentrations of conventional and toxic pollutants; information on greenhouse gas emissions alone may not reveal whether such increases are occurring. The FED also proposes to "solicit information" from local air districts concerning new and modified permits, and to evaluate this information at least once per compliance period (i.e., once every three years). FED at 47, 51. This information, however, will not contain data on pollution increases that fall below permitting thresholds. Nor will this information capture pollution increases associated with increasing production to limits in existing permits.⁶⁰ Nor will a triennial review disclose pollution increases in time to develop an "appropriate" response.

In sum, the FED's "adaptive management" approach will not prevent significant environmental effects, and will not permit ARB to respond to unanticipated effects in a timely or effective manner. Absent specific performance standards, timely and rigorous monitoring of all relevant information, and particularized responses to triggering events, "adaptive management" remains little more than a smokescreen for inadequate analysis of environmental impacts.

must clarify these inconsistencies and ameliorate these defects before approving the cap-and-trade regulation.

⁶⁰ The FED conclusorily dismisses increases associated with air permit "headroom," concluding that facilities like oil refineries hold dozens of permits, modifications of which might be triggered by increased production. *See* FED at 94. The FED's approach is without foundation. First, the FED seems to conclude that no facility would increase production if doing so required a permit, due to the "public review" and environmental scrutiny associated with permitting. Yet facilities routinely obtain air permits from California air districts and may be expected to do so in the future, "public review" notwithstanding. A permit requirement by itself does not mean that pollution levels never will increase. Second, the FED appears to treat all permitted facilities as if they were refineries with multiple permits. The existence of one type of facility where "headroom" expansion might trigger permit requirements does not prove that no "headroom" expansion will occur at any other type of facility.

Other, more specific shortcomings of the FED are discussed in detail below.

A. The FED Fails to Disclose, Analyze, and Propose Adequate Mitigation for Impacts Related to the Forest Protocol

The Forest Offset Protocol proposed in the cap-and-trade regulation is nearly identical to the Forest Project Protocol prepared by the Climate Action Reserve. For example, as previously discussed, the Forest Offset Protocol continues to allow and incentivize even-aged management practices such as clearcutting that imperil forest health, water quality, and biodiversity; continues to provide incentives for conversion of native forests to plantations; continues to contain loopholes that incentivize increased short-term logging (and associated GHG emissions); and continues to offer credits for non-additional forest management activities in a manner that could increase overall GHG emissions. The impacts associated with these incentives and loopholes have been detailed in a series of letters from the Center to both the Climate Action Reserve and ARB over the past year.⁶¹ The FED largely fails to address the specific impacts identified in this series of letters. Accordingly, the arguments raised in those letters apply with equal force to the Forest Offset Protocol proposed in connection with the cap-and-trade program. These letters are therefore attached and incorporated by reference.

The FED attempts to dismiss concerns that the Forest Offset Protocol will incentivize clearcutting and conversion of native forests on the theory that such practices will not significantly increase carbon storage. FED at 304-05. The conclusion is dubious, and contradicted by the record of protocol development; throughout the Climate Action Reserve's protocol development process, timberland owners and other prospective forest project proponents repeatedly insisted that clearcutting and conversion of mature, uneven-aged forests were necessary to maximize carbon sequestration. This conclusion also is purportedly based on a study of "several California forest types." *Id.* at 304. However, the Forest Offset Protocol applies not just in California, but throughout the continental United States. Thus the FED is devoid of any analysis as to whether the Forest Offset Protocol will incentivize clearcutting and conversion of native forests outside California. Indeed, the FED acknowledges that out-of-state projects may not be subject to the level of environmental analysis that would accompany California or federal projects. *Id.* at 306. The FED's conclusions that the Forest Offset Protocol will not incentivize clearcutting and conversion lack support.

Despite these conclusions, the FED acknowledges that the Forest Offset Protocol may significantly affect biological resources. FED at 313-14. The FED proposes that ARB mitigate these effects by implementing "adaptive management." As previously discussed, "adaptive

⁶¹ See Letter to ARB Re: CEQA Violations in Adoption of Forest Project Protocols (Nov. 9, 2009); Letter to ARB Re: Continuing CEQA Violations in Adoption of Forest Project Protocols (Jan. 11, 2010); Letter to ARB Re: Revisions to the Forest Project Protocol (Aug. 4, 2010); Letter to ARB Re: Review of the environmental impacts and co-benefits of an AB 32 cap-and-trade program (Sept. 10, 2010).

management,” as proposed in the FED, does not constitute effective or legally permissible mitigation for these foreseeable impacts.

In any event, it is unlikely that the adaptive management program proposed in the FED would allow ARB even to detect, much less ameliorate, the adverse consequences of the Forest Offset Protocol. The FED proposes to collect information only from annual project verification reports and from “periodic” solicitation of public and stakeholder comments. FED at 313. This information, however, will not reveal whether project proponents changed management strategies, in response to the availability of offset credits, in a manner destructive of biological or forest resources. At the very least, a more credible adaptive management program would need to collect a great deal of additional information concerning historical harvest practices at the ownership and landscape scale, changed management practices following enrollment of projects under the Forest Offset Protocol, and continuous monitoring of ecological indicators (including species population trends and water quality) on project lands. The program also would have to establish specific benchmarks or performance standards—for example, a certain amount of natural forest converted to plantations, or a certain amount of uneven-aged forest converted to clearcut rotations—that would trigger specific ameliorative responses. Absent adequate information, specific performance thresholds, and particularized responses, the FED’s “adaptive management” program cannot function as a mitigation measure for the Forest Offset Protocol.

B. The FED Fails to Disclose, Analyze, and Propose Mitigation for Impacts Related to the Biomass and Biofuels Exemption.

Adoption of a regulation is a “project” for CEQA purposes, and the courts have recognized that CEQA requires analysis of environmental impacts associated with a regulation that creates incentives for particular actions. *See Cal. Unions for Reliable Energy v. Mojave Desert Air Qual. Mgmt. Dist.*, 178 Cal. App. 4th 1225, 1244-45 (2009). The FED here completely fails to disclose, analyze, or propose mitigation for the reasonably foreseeable and likely significant effects of exempting all biomass and biofuels emissions from compliance obligations.

This exemption creates a strong incentive to burn biomass fuels in at least two ways. First, emissions from biomass and biofuels combustion do not give rise to any compliance obligation, and thus will not require purchase or retirement of allowances or offsets. This will encourage use of biogenic fuels wherever fuel-switching is cheaper than the purchase of allowances or offsets.

Second, the biomass and biofuels exemption leaves a number of facilities that already use these fuels outside the cap. Those facilities, however, could choose to “opt in” to the program for the purpose of obtaining allowances. *See Proposed Reg. § 95813*. Emissions from those facilities would be evaluated against an “efficiency benchmark” based on natural gas combustion. ISOR at II-31. According to the ISOR, “if a facility used a cleaner fuel source, *like biomass*, or combusts the fuel more efficiently, it would be rewarded with more allowances relative to its actual emissions.” *Id.* (emphasis added). This not only assumes without any

support that biomass combustion is “cleaner” than natural gas, but also creates a strong incentive for biomass-fueled facilities to “opt in” to the cap-and-trade program for the purpose of obtaining valuable allowances while at the same time escaping any compliance obligation. *See* Proposed Reg. §§ 95812(a), 95852.2. The proposed rules thus potentially create a double “freebie” for biomass combustion: an exemption from compliance obligations, coupled with a program for distributing free allowances *for that same combustion* that may be sold into the market and used to justify emissions at other facilities. This double “freebie” not only incentivizes biomass and biofuels use but also risks a form of allowance double-counting that could ultimately increase GHG emissions overall.

The FED fails to disclose, analyze, and propose mitigation for the foreseeable effects of these incentives. Indeed, the FED completely fails to discuss many of the foreseeable impacts of incentivizing “decarbonization” compliance pathways involving biomass and biofuels. The only oblique mention of such impacts is in the context of cement plants using old tires to fire kilns (a process by which the natural rubber portion of the tires could be “credited as biomass”). FED at 153. Other foreseeable compliance pathways involving biomass and biofuels combustion are simply not discussed. The FED similarly contains no analysis of the impacts of incentivizing these pathways on forest resources, biological resources, geology and soils, or water quality—even though creating an incentive for biomass usage will foreseeably increase biomass harvests. This is a glaring—and unlawful—omission.

Burning trash, tires, and wood in place of other fuels may increase local emissions of criteria and toxic pollutants. Large-scale replacement of other energy sources with biomass will also put increased pressure on forest ecosystems, with resultant impacts on biodiversity, water quality, and forest health. The potential for these impacts is well-documented; indeed, one recent study concludes that a wide-scale shift to woody biomass energy generation could eventually result in conversion of nearly all of the world’s unmanaged forests and much of its pastureland to energy plantations.⁶² Significant impacts associated with increased biomass usage may already be anticipated to result from renewable energy standards and a plethora of state and federal subsidies for biomass development. In this context, an exemption from compliance obligations for biomass emissions under the cap-and-trade program at the very least constitutes a considerable contribution to a cumulatively significant effect. The FED fails to consider this.

Finally, the FED fails to adequately address the effects of the biomass exemption on overall greenhouse gas emissions. The document concludes that switching to “less carbon-intensive” fuels will produce a “beneficial effect” in terms of greenhouse gas emissions. FED at 184. Yet the core assumption underlying this conclusion—that biomass emissions are “carbon neutral”—is both unstated and unsupported. Accordingly, biomass and biofuels may not be “less carbon-intensive” than the fuels or energy sources they replace, especially over the time frame relevant to AB 32, and especially if the replaced sources come from other potentially more costly renewables like wind and solar. Absent a protocol for tracking the sources of biomass fuels, evaluating the carbon debts associated with particular fuel sources, and reaching a

⁶² *See* Wise et al. (2009).

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defensible conclusion as to the real carbon footprint of biomass, the FED cannot rationally conclude that the biomass exemption confers an environmental benefit.

C. The FED Fails to Consider a Range of Reasonable Alternatives that Could Lessen the Proposed Rule's Impacts.

Under CEQA, the FED must consider a range of reasonable alternatives that would feasibly attain most of the objectives of the cap-and-trade regulation while avoiding or substantially lessening its significant impacts, and must compare the relative merits of these alternatives. CEQA Guidelines § 15126.6(a). The FED fails to consider any alternative formulations of the Forest Offset Protocol that could meet these standards.

The Center and numerous other organizations have proposed alternative formulations to ARB throughout the past year. For example, ARB could have considered a version of the Forest Offset Protocol that eliminated clearcutting and other forms of even-aged management. ARB also could have considered restricting the conversion of uneven-aged, native forests to fast-growing plantations, and could have considered the inclusion of additional carbon pools. Finally, ARB could have considered a version of the protocol that corrected additionality problems caused by the protocol's failure to incorporate long-term sustained yield plans into the project baseline. These alternatives, alone or in combination, would have advanced many of the core objectives of the cap-and-trade program. Had ARB considered these alternatives, it could have compared them, alone or in combination, to the proposed Forest Offset Protocol, and evaluated their feasibility.

The FED failed to do so. Instead, the FED purports to have rejected “environmental performance standards” for all compliance protocols. FED at 370. According to the FED, such standards are infeasible because (a) they are unnecessary, given the existence of strong environmental laws in California; (b) they would be difficult to apply outside of California due to differences in local law; (c) it would be impossible to create performance standards that work across a wide range of project locations and conditions; and (d) implementing standards would create an administrative burden affecting the functioning of the offset market. *Id.*

The FED's rejection of environmental performance standards is puzzling at best—and disingenuous at worst—given that *similar environmental standards already have been incorporated into every protocol ARB has proposed for adoption*. These standards, such as the natural forest management requirement for forest projects and the limitation on clearcut size, have been applied regardless of California or local law, regardless of differences in project locations and conditions, and regardless of administrative burden. ARB cannot rationally reject alternative formulations of these standards as “infeasible” when the factors supposedly rendering them infeasible are common to the proposed project as well.

In order to reject an alternative as infeasible, the FED must set forth adequate quantitative, comparative data to enable the public and decision-makers to reach a rational conclusion. *See, e.g., Save Round Valley Alliance*, 157 Cal. App. 4th at 1461-62; *Uphold Our*

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Heritage, 147 Cal. App. 4th at 600. The FED does not even identify the particular “environmental performance standards” that it supposedly finds infeasible, much less present adequate data and analysis in support of its conclusions. Accordingly, the FED’s approach is unlawful, and the document must be revised to include discussion of a range of reasonable alternatives to Forest Offset Protocol design—including the alternatives identified above and in prior communications with ARB—that could ameliorate environmental effects while furthering AB 32’s objectives.

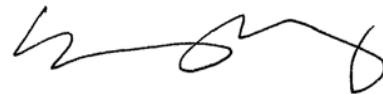
Conclusion

Thank you for your consideration of these comments. Please do not hesitate to contact us if you have any questions.

Sincerely,



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APPENDIX A
Exhibits to Center for Biological Diversity Comments
Proposed Cap and Trade Regulation
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All files uploaded to www.arb.ca.gov (capandtrade10) in zipped PDF format

Exhibit	Title
1	Reed F. Noss, <i>Beyond Kyoto: Forest Management in a Time of Rapid Climate Change</i> , 15 CONSERVATION BIOLOGY 578 (2001).
2	D.P. Turner, et al., <i>A carbon budget for forests of the conterminous United States</i> , 5 ECOLOGICAL APPLICATIONS 421 (1995).
3	Mark E. Harmon, et al., <i>Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests</i> , 247 SCIENCE 699 (1990).
4	Brendan Mackey, et al., <i>Green carbon: the role of natural forests in carbon storage. Part 1, A green carbon account of Australia's south-eastern Eucalypt forest, and policy implications</i> , The Fenner School of Environment & Society, The Australian National University (2008).
5	Robert Jandl, et al., <i>How Strongly Can Forest Management Influence Soil Carbon Sequestration?</i> , 137 GEODERMA 253 (2007).
6	R. Birdsey and L. S. Heath, <i>Carbon Changes in U. S. Forests</i> , in PRODUCTIVITY OF AMERICA'S FORESTS AND CLIMATE CHANGE (GTR-RM-271), edited by L. A. Joyce: USDA Forest Service, Rocky Mountain Research Station (1995).
7	Mark E. Harmon, 2009, <i>Woody Detritus Mass and its Contribution to Carbon Dynamics of Old-Growth Forests: the Temporal Context</i> , in C. Wirth et al. (eds.), OLD-GROWTH FORESTS, Ecological Studies 207 (2009).
8	Center for Biological Diversity, Letter to Climate Action Reserve Re: Preliminary Guidance on Forest Project Protocol, Section 6.2.1.1 (Legal Requirements for Project Baseline; Supplemental Comments) (April 30, 2010).
9	Center for Biological Diversity, Letter to Climate Action Reserve Re: Comments on Proposed Amendments to Baseline Determination of the Forest Project Protocol Version 3.1 (July 30, 2010).
10	Manomet Center for Conservation Sciences, <i>Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources</i> (2010).
11	Gregory P. Asner, et al., <i>High-Resolution Forest Carbon Stocks and Emissions in the Amazon</i> , PROC. NAT'L ACADEMY OF SCI. EARLY EDITION, available at http://www.pnas.org/content/early/2010/08/30/1004875107 (last visited Sept. 12, 2010).
12	Michael G. Ryan, et al., <i>A Synthesis of the Science on Forests and Carbon for U.S. Forests</i> , Ecological Society of America: Issues in Ecology, Report No. 13 (Spring 2010).
13	Eric Johnson, <i>Goodbye to Carbon Neutral: Getting Biomass Footprints Right</i> , 29 ENVTL. IMPACT ASSESSMENT R. 165 (2008).

14	Jerry M. Melillo, et al., <i>Indirect Emissions from Biofuels: How Important?</i> SCIENCEEXPRESS 10.1126/science.1180251 (Oct. 22, 2009).
15	World Res. Inst., <i>State of the World's Forests</i> (Jan. 8, 2009), at http://www.wri.org/map/state-worlds-forests (last visited Sept. 12, 2010).
16	Matthew C. Hansen, et al., <i>Quantification of Global Gross Forest Cover Loss</i> , 107 PROC. NAT'L ACADEMY OF SCI. 8650 (May 11, 2010).
17	COMMITTEE ON STABILIZATION TARGETS FOR ATMOSPHERIC GREENHOUSE GAS CONCENTRATIONS; NATIONAL RESEARCH COUNCIL, <i>STABILIZATION TARGETS FOR ATMOSPHERIC GREENHOUSE GAS CONCENTRATIONS</i> (National Academies Press 2010) (excerpts).
18	Anna Repo, et al., <i>Indirect Carbon Dioxide Emissions from Producing Bioenergy from Forest Harvest Residues</i> , GLOBAL CHANGE BIOLOGY BIOENERGY (2010).
19	Alexander Gershenson et al., <i>Accounting for Carbon in Soils</i> , Climate Action Reserve White Paper (2010).
20	Mary S. Booth, <i>Review of the Manomet Biomass Sustainability and Carbon Policy Study</i> (July 2010).
21	Tara Hudiburg, et al., <i>Carbon Dynamics of Oregon and Northern California Forests and Potential Land-Based Carbon Storage</i> , 19 ECOLOGICAL APPLICATIONS 163 (2009).
22	Mark E. Harmon, et al., <i>Effects of Partial Harvest on the Carbon Stores in Douglas-fir/Western Hemlock Forests: A Simulation Study</i> , 12 ECOSYSTEMS 777 (2009).
23	Brooks M. Depro, et al., <i>Public Land, Timber Harvests, and Climate Mitigation: Quantifying Carbon Sequestration Potential on U.S. Public Timberlands</i> , 255 FOREST ECOLOGY & MGMT. 1122 (2008).
24	Heather Keith, et al., <i>Re-evaluation of Forest Biomass Carbon Stocks and Lessons from the World's Most Carbon-Dense Forests</i> , 106 PROC. NAT'L ACADEMY OF SCI. 11,635 (2009).
25	Lucas E. Nave, et al., <i>Harvest Impacts on Soil Carbon Storage in Temperate Forests</i> , 259 FOREST ECOLOGY & MGMT. 857 (2010).
26	Stephen R. Mitchell, et al., <i>Forest Fuel Reduction Alters Fire Severity and Long-Term Carbon Storage in Three Pacific Northwest Ecosystems</i> , 19 ECOLOGICAL APPLICATIONS 643 (2009).
27	CHAD HANSON, <i>THE MYTH OF "CATASTROPHIC" WILDFIRE: A NEW ECOLOGICAL PARADIGM OF FOREST HEALTH</i> (2010).
28	Giuliana Zanchi et al., <i>The Upfront Carbon Debt of Bioenergy</i> (May 2010).
29	James Hansen, et al., <i>Target Atmospheric CO₂: Where Should Humanity Aim?</i> , 2 OPEN ATMOS. SCI. J. 217 (2008).
30	Alliance of Small Island States, <i>Declaration on Climate Change 2009</i> (Sept. 21, 2009).
31	B. Hare & M. Meinshausen, <i>How Much Warming Are We Committed To and How Much Can Be Avoided?</i> , 75 CLIMATIC CHANGE 111 (2006).
32	IAN ALLISON, ET AL., <i>THE COPENHAGEN DIAGNOSIS: UPDATING THE WORLD ON THE LATEST CLIMATE SCIENCE</i> (2009).

33	M. den Elzen & N. Höhne, <i>Reductions of Greenhouse Gas Emissions in Annex I and Non-Annex I Countries for Meeting Concentration Stabilisation Targets</i> , 91 CLIMATIC CHANGE 249 (2008).
34	M. O'Hare et al., <i>Proper Accounting for Time Increases Crop-Based Biofuels' Greenhouse Gas Deficit Versus Petroleum</i> , 4 ENVTL. RESEARCH LETT. 024001 (2009).
35	U.S. EPA, <i>EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels</i> (2009).
36	MARY S. BOOTH AND RICHARD WILES, CLEARCUT DISASTER: CARBON LOOPHOLE THREATENS U.S. FORESTS (Environmental Working Group 2010).
37	Timothy Searchinger, et al., <i>Fixing a Critical Climate Accounting Error</i> , 326 SCIENCE 527, 527 (2009).
38	Cal. Energy Comm'n, <i>California Energy Demand 2010-2020: Adopted Forecast</i> , Report No. CEC-200-2009-012-CMF (Dec. 2009) (Exec. Summ.).
39	Sierra Pacific Indus., Media Release, <i>Sierra Pacific Industries to Close its Loyaltan, CA Power Plant</i> (Aug. 20, 2010).
40	Marshall Wise, et al., <i>Implications of Limiting CO₂ Concentrations for Land Use and Energy</i> , 324 SCIENCE 1183 (2009).
41	Garrett W. Meigs, et al., <i>Forest Fire Impacts on Carbon Uptake, Storage, and Emission: The Role of Burn Severity in the Eastern Cascades, Oregon</i> , 12 ECOSYSTEMS 1246 (2009).
42	Garrett W. Meigs and John L. Campbell, <i>Comment on "Prescribed Fire As a Means of Reducing Forest Carbon Emissions in the Western United States"</i> 44 ENVTL. SCI. & TECH. 6250 (2010) (prepublication version).
43	Timothy Searchinger, <i>Biofuels and the Need for Additional Carbon</i> , ENVIRON. RES. LETT. 5 (2010) 024007.
44	Rhett A. Butler, et al., <i>REDD in the Red: Palm Oil Could Undermine Carbon Payment Schemes</i> , 2 CONS. LETT. 67 (2009).
45	Birka Wicke, et al., <i>Different Palm Oil Production Systems for Energy Purposes and their Greenhouse Gas Implications</i> , 32 BIOMASS AND BIOENERGY 1322 (2008).
46	Holly K. Gibbs, et al., <i>Carbon Payback Times for Crop-Based Biofuel Expansion in the Tropics: The Effects of Changing Yield and Technology</i> , ENVIRON. RES. LETT. 3 (2008) 034001.
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