June 12, 2015

Comments submitted electronically at:
http://www.arb.ca.gov/lispub/comm2/bcsubform.php?listname=slcpstrategyws&comm_period=1

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Re: Short-Lived Climate Pollutant Reduction Strategy Concept Paper

Dear Mr. Mehl,

Please accept these comments submitted on behalf of the Center for Biological Diversity and our over 100,000 members and supporters in California, regarding the Short-Lived Climate Pollutant Reduction Strategy Concept Paper released on May 7, 2015.[1]

We commend the outstanding work done by the Air Resources Board and staff to develop this concept paper. ARB has done an outstanding job summarizing the impacts of short-lived climate pollutants and highlighting the need to achieve steep reductions in these pollutants. We strongly support ARBs position of calling for improved data quality and research while simultaneously promoting immediate action.[2] This concept paper provides an excellent foundation for California to be a national leader in addressing these pollutants and achieving meaningful reductions in climate change-induced global warming.

We strongly support moving forward with developing and implementing measures to achieve deep reductions in short-lived climate pollutant (SLCP) emissions as quickly as possible, to reduce greenhouse gas emissions and improve air quality. These comments are offered to identify outstanding questions and strengthen the measures proposed in the concept paper.

[1] California Air Resources Board, *Short-lived Climate Pollutant Reduction Strategy* at 4 (May 7, 2015) [hereinafter "concept paper"].
[2] Concept paper at 15: "While improving data access and quality is not prerequisite for many actions to reduce emissions of SLCPs, it is important for informing ongoing efforts to reduce emissions to necessary levels from these sources."

I. The SLCP strategies Must Be Based on the Most Current Values for Methane's Global Warming Potential.

We commend ARB for analyzing short-lived climate pollutants on both a 20-year and 100-year time scale. As the concept paper correctly notes, we must achieve short-term reductions in radiative forcing if we wish to avoid reaching climate tipping points and avoid catastrophic warming in the Arctic.[3] It is essential to compare climate pollutants using a normalizing parameter, such as global warming potential ("GWP"), that reflects the time scale of the policy concern. With regard to avoiding irreversible warming and potential tipping points, this clearly means the 20-year time scale for GWPs is the appropriate choice.

However, the concept paper falls short of accurate analysis because it employs outdated methane GWPs from the Intergovernmental Panel on Climate Change ("IPCC") Fourth Assessment Report ("AR4"). That report is by now five years old; in the interim, the IPCC has released its Fifth Assessment report. One of the IPCC Fifth Assessment Report's ("AR5") breakthrough insights is the discovery of a fundamental flaw in previous calculations of GWP: the climate effect of CO_2 intrinsically includes carbon cycle feedbacks, but the GWPs of other greenhouse gases do not.[4] Thus, to accurately compare the climate effects, it is necessary to include these feedbacks in the estimates of all greenhouse gas emissions. The AR5 methane GWP of 34 is significantly higher than AR4 – 36 percent higher. The AR5 20-year GWP is 86 (19% higher than the AR4 GWP). These substantial increases in GWP mean that emissions analyzed using AR4 GWPs or are significantly underestimated.

While the concept paper uses the AR5 value for black carbon, for methane it uses only the AR4 values that lack climate feedbacks. [5] This omission results in serious inaccuracies in how the report presents and compares the respective greenhouse gases' climate change impacts. While we understand that international reporting requirements for methane use AR4 values, the SLCP concept paper is being employed for the development and analysis of reduction measures, a purpose separate from international commitments, and one that requires precise quantification of climate impacts. To provide accurate and useful guidance for the development of SLCP reduction measures, ARB must use the most current values for methane's global warming potential: a 100-year GWP of 34 and a 20-year GWP of 86.[6]

II. We strongly support further efforts to reduce particulate matter and black carbon from biomass burning.

Existing policies, especially ARB's Diesel Risk Reduction Plan and the wood-burning restrictions of some local air districts, have made great progress in reducing emissions of particulate matter and black carbon. Further progress in these programs and similar ones is

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[3] Concept paper at 4.

[4] G. Myhre et al., *Anthropogenic and Natural Radiative Forcing*, in CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE IPCC 713 (Cambridge Univ. Press 2013).

[5] Concept Paper at 10.

[6] G. Myhre et al., *2013, supra* note 3. These are values for "biogenic" methane; fossil sources should be analyzed using GWP's of 36 and 87, respectively.

essential to safeguarding our air and climate. ARB could play a role, through research and funding, in supporting local air districts that are acting to reduce emissions from biomass burning, such as the rule under consideration at the Bay Area Air Quality Management District to ban all wood burning devices in new construction and restrict the sale of buildings with old wood-burning devices that fail to meet USEPA standards. Such measures are important in fulfilling the mandate of SB 605 to prioritize measures that reduce air pollutants that impact community health.[7]

The discussion of diesel black carbon emissions identifies off-road diesel sources where additional efforts are needed.[8] We urge ARB to include diesel equipment at oil and gas operations and flaring at oil and gas operations.

III. Forests and Fires Must Be Approached as Natural Components of the Ecosystem and Carbon Cycle.

Forests are different from other sources of short-lived climate pollutants like fluorinated gases from industrial refrigerants, methane from cattle operations, and black carbon from diesel engines, in that forests and forest fires are natural components of the world carbon cycle. In California, for example, fire plays an essential role in supporting functional forest ecosystems. Actions that seek to influence forest structures and natural processes like fire are therefore going to have a range of effects at multiple scales on forest ecosystems, wildlife, and water. All of these effects need to be considered in the development of forest-related measures.

In particular, forest thinning in the name of fire risk reduction can have significant adverse effects on forest ecosystems, wildlife and habitat, and water quality.[9] The underlying premise that forest thinning is necessary to avoid severe fire ignores the critical role that such fire plays in creating habitat for wildlife. Many species rely on severely burned forest as habitat and food source, and many past fires that have been characterized as "catastrophic"—such as the Chips, Moonlight, McNally, Rim and Storrie fires—have been found to provide some of the most important wildlife habitat in California's forested ecocosystems.[10] Moreover, studies have

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[7] Senate Bill 605 (Lara, Chapter 523, Statutes of 2014). Chapter 4.2, Part 2 of Division 26 of the Health and Safety Code, § 39730: "In developing the strategy, the state board shall do all of the following: ... (4) Prioritize the development of new measures for short-lived climate pollutants that offer cobenefits by improving water quality or reducing other air pollutants that impact community health and benefit disadvantaged communities..."

[8] Concept paper at 24: "While existing policies and processes effectively target particulate matter and black carbon emissions from on-road sources, additional efforts are needed to drive reductions from off-road sources, including farm and construction equipment, trains and railroad operations, cargo handling equipment, and shipping."

[9] Concept paper at 10: "Improving management and health of forests and rural landscapes to mitigate black carbon emissions from wildfires and biomass burning can help bring investment, economic, and climate resiliency benefits throughout the Sierra and other rural parts of California."

[10] See, *e.g.,* M.L. Bond, et al. 2009. *Habitat use and selection by California Spotted Owls in a postfire landscape*. Journal of Wildlife Management 73: 1116-1124; M.R. Buchalski, et al. 2013. *Bat response to differing fire severity in mixed-conifer forest, California, USA*. PLOS ONE 8: e57884. R.D.Burnett, et al. 2011. *Plumas Lassen Study 2010 Annual Report*. U.S. Forest Service, Pacific Southwest Region, Vallejo, CA.; R.D. Burnett, et al. 2012. *Plumas Lassen Study 2011 Annual Report*. U.S. Forest Service, Pacific Southwest Region, Vallejo, CA; M.I. Cocking, et al. 2014. *Long-term effects of fire severity on oak-conifer dynamics in the southern Cascades*. Ecological Applications 24: 94-107; Hanson, C.T. 2014. *Conservation concerns for Sierra Nevada birds associated with high-severity fire*. Western

found that fire—including high-severity forest fire—is and always has been critical to the ecological function of California's forests.

These issues apply as well to the consideration of measures that would enhance wild land fire prevention and suppression.[11] The concept paper's statements on the potential for preventing forest fires, and precisely what kinds of actions might be effective at achieving such prevention, rely on a number of narrow assumptions and generalizations that need to be fully explicated and analyzed.[12] For example, whether or not thinning will result in any fire impact at all relies on the assumptions that a) the thinned area will burn and will burn within the time period that thinning can impact fire behavior, b) the thinned area would have burned at high severity absent the thinning treatment (an assumption that is often not borne out in actual fires, as many densely forested areas do not burn at high severity when they burn), and c) thinning will result in changing fire behavior, which may not be true, s such treatments may become irrelevant during severe weather conditions.[13]

We strongly support the proposal to explore research into prescribed fire, and we believe this effort should not be confined to the context of reducing fire risk and instead must also address the ecological role of fire on the landscape.[14] We urge that measures adopted as part of the SLCP strategies integrate with efforts to increase forest carbon storage and work at a watershed or regional scale to allow for fire across substantially large areas at mixed severity.

Birds 45:204–212; Hutto, R. L. 2008. *The ecological importance of severe wildfires: Some like it hot*. Ecological Applications 18:1827–1834; Malison, R.L., and C.V. Baxter. 2010. Canadian Journal of Fisheries and Aquatic Sciences 67: 570-579; Manley, P. N., and G. Tarbill. 2012. *Ecological succession in the Angora fire: The role of woodpeckers as keystone species*. *Final Report to the South Nevada Public Lands Management Act*. U.S. Forest Service; R.B. Siegel, et al. 2012. *Black-backed Woodpecker MIS surveys on Sierra Nevada national forests: 2011 Annual Report*. A report in fulfillment of Forest Service Agreement No. 08-CS-11052005-201, Modification #4.; U.S. Forest Service Pacific Southwest Region, Vallejo, CA; R.B. Siegel, et al. 2013. *Assessing home range size and habitat needs of Black-backed Woodpeckers in California: Report for the 2011 and 2012 field seasons*. Institute for Bird Populations; R.B. Siegel, et al. 2014. *Assessing home-range size and habitat needs of Black-backed Woodpeckers in California: Report for the 2013 field season*. Report to USFS Pacific Southwest Region. The Institute for Bird Populations, Point Reyes Station, CA; M.W. Tingley, et al. 2014. *Variation in home range size of Black-backed Woodpeckers (*Picoides arcticus*)*. The Condor: Ornithological Applications*.* 116:325–340. DOI: 10.1650/CONDOR-13-140.1; B.R. Campos, and RD. Burnett. 2015. *Avian monitoring of the Storrie and Chips Fire areas: 2014 report*. Point Blue Conservation Science, Petaluma, CA.

[11] Concept paper at 25: "Potential management practices to minimize GHG emissions could include measures that would enhance wild land fire prevention and suppression, resulting in avoidance of direct black carbon emissions."

[12] Concept paper at 25: "No single wildfire may be preventable, but improved management can reduce the incidence and severity of wildfires in California, which can offer climate benefits by both strengthening our forests as carbon stocks and sinks, and reducing black carbon (and brown carbon) emissions from wildfires. Additionally, the impacts of climate change are expected to make wildfires more frequent and severe, and our forests need to increasingly be managed with climate change impacts in mind."

[13] See, e.g., Lydersen et al. 2014. *Severity of an uncharacteristically large wildfire, the Rim Fire, in forests with relatively restored frequent fire regimes*. Forest Ecology and Management 328 (2014) 326–334. "[Our] results suggest that wildfire burning under extreme weather conditions, as is often the case with fires that escape initial attack, can produce large areas of high-severity fire even in fuels-reduced forests..."

[14] Concept paper at 25: "ARB will explore research related to how we can most effectively prioritize areas where the use of prescribed fire will have the greatest reduction in wildfire risk, and associated net black carbon impacts, at the lowest cost, and with the least impact to residents at the urban-wildland interface."

Restoring natural structural diversity and fire to forests, at multiple scales, is essential to promoting and achieving the goals of increased forest carbon stocks, enhanced habitat, and improved watershed health. Moreover, forest-related measures must include the goal that forest ecosystems include the full range of naturally occurring habitat types, especially complex early seral[15] and complex late seral conditions given the significant harmful impacts that thinning causes to these ecologically essential forest types.

Forest strategies must be integrated with and support well-functioning natural systems. To avoid unintended consequences and foster multiple benefits, forest-related goals must include criteria for evaluating associated environmental impacts and benefits, including wildlife habitat, structural diversity, and stream and watershed health.

IV. Any Effort to Influence Forest Fire Behavior and Emissions Must Account for All Climate-Relevant Effects.

The strategy to influence forest fire behavior must account for all climate-relevant impacts of those measures, not just black carbon emissions. Forest thinning treatments, intended to reduce fuel loads and wildfire intensity, by definition remove a great deal of carbon from the forest—by some estimates, about three times as much carbon as might be avoided by reducing wildfire emissions.[16] These activities reduce terrestrial carbon stocks at the same time that they reduce ongoing and future carbon sequestration at various scales. As with efforts to increase forest carbon sequestration, SLCP strategies must account for climate impacts at the site level, as well as regional and state scales. These methods should include all climate impacts, including increased CO_2 emissions from biomass conversion and impacts to forest carbon stores, and be compatible with and include timescales relevant to both short-term and long-term climate goals.

The Low Carbon Fuel Standard workgroup took up the issues of GHG accounting and carbon intensity for forest activities, issues that have much relevance to potential SLCP measures. In those discussions, as in the supporting science, it has become clear that accounting for GHG impacts of forest activities is critical to determining the overall GHG impact and carbon intensity of the end use of forest-sourced materials. It has also become clear that, with respect to accounting for those GHG impacts, one size does not and cannot fit all, and GHG impacts need to be determined at the project level.

"Sustainability" standards are not an adequate proxy for accurate carbon accounting. Nor does "sustainable forest management," as defined by CalFire for the purposes of SB 1122, or by reference to "sustained yield" criteria under California law, provide a framework for GHG accounting. SB 1122 mandated procurement of 50 MW of bioenergy using "byproducts of sustainable forest management" as fuel, but neither SB 1122 nor the PUC's decision

[15] See D.A. DellaSala, et al. 2014. *Complex early seral forests of the Sierra Nevada: what are they and how can they be managed for ecological integrity*? Natural Areas Journal 34: 310-324.

[16] See John L. Campbell, et al., *Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions?* Front. Ecol. Env't (2011), doi:10.1890/110057.

implementing the statute attempted to assess the GHG impacts of feedstocks used by those facilities.[17]

Furthermore, accurate accounting of the climate impacts of black carbon also should incorporate the impacts of other aerosols. Many of the processes that produce black carbon (e.g., fires) also produce carbonaceous and non-carbonaceous aerosols.[18] The climate implications of these aerosols are largely warming, but the lightest-colored organic carbon molecules and NOx aerosols may have some cooling effect that should be taken into account in estimating the climate impacts of fire.[19] This is an area in which more research is necessary to accurately estimate the climate impacts of forest fires, and thus the climate benefits associated with fire prevention.

V. The SLCP Strategy Must Account for the High Carbon Costs Associated with Burning Wood.

Because bioenergy production converts large amounts of carbon to atmospheric CO_2 regardless of what technology is used, a full accounting of the climate impacts is necessary in assessing the ultimate GHG reductions to be achieved by SLCP strategies related to biomass energy. Wood-burning power plants emit roughly three times as much CO_2 at the smokestack as natural gas plants per megawatt-hour of energy produced.[20] This excess CO_2 can persist in the atmosphere for decades or even centuries, depending on the source of the wood used as fuel, even when "net" CO_2 reductions from forest regrowth or avoided emissions are taken into account. It is not an atmospheric benefit to reduce black carbon emissions from fire if, in doing so, we simultaneously increase CO_2 emissions through the combustion or conversion of biomass in bioenergy or biofuel facilities.[21]

Moreover, wood-burning power plants produce far higher quantities of air pollutants like nitrogen oxides, particulate matter, and carbon monoxide per megawatt-hour than the natural gas plants they are intended to displace. Furthermore, expanded utilization of biomass, especially wood sourced from forests, could drive demand for more intensive logging operations that can harm habitat, wildlife, and water quality. All of these values would need to be considered to fulfill the mandate of SB 605 to prioritize measures that offer co-benefits by improving water

[17] See Public Utilities Code § 399.20(f)(2)(A)(iii) (requiring procurement of 50 MW of generation using "byproducts of sustainable forest management," but not defining "sustainable forest management" or making any reference to GHG accounting); Public Utilities Commission Decision No. 14-12-081 at 21-32 (Dec. 26, 2014) (defining "byproducts of sustainable forest management" solely for purposes of SB 1122, and making no findings regarding greenhouse gas or climate implications of definition).

[18] See*, e.g.,* D.G. Kaskaoutis, et al., Satellite monitoring of the biomass-burning aerosols during the wildfires of August 2007 in Greece: Climate implications. Atmospheric Environment 45 (2011) 716-726.

[19] See*, e.g*., Chul E. Chung, et al., Observationally constrained estimates of carbonaceous aerosol radiative forcing. PNAS 2012. www.pnas.org/cgi/doi/10.1073/pnas.1203707109.

[20] See, John L. Campbell, et al., *Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions?* Front. Ecol. Env't (2011), doi:10.1890/110057.

[21] Concept paper at 25: "As for other organic waste streams, the Strategy will explore options to put woody biomass to beneficial use and avoid black carbon emissions that would otherwise result from burning."

quality or reducing other air pollutants that impact community health and benefit disadvantaged communities.

VI. The SLCP Strategy for Biochar Must Take Into Account the Emissions and Uncertainties Related to Sequestration.

The concept paper discusses biochar as a potential option "to put woody biomass to beneficial use and avoid black carbon emissions that would otherwise result from burning."[22] And while the concept paper acknowledges the research gaps and lack of certainty regarding large-scale projects, it is less clear about the large degree of uncertainty related to the climate benefits associated with biochar sequestration generally.

The empirical evidence of long-term persistence of biochar in agricultural soils is inconsistent and equivocal.[23] Persistence of biological carbon in soils depends not only on the physical properties of the biological carbon, but also to a highly significant extent on ecosystem conditions.[24] Variability in local soil microbial community composition can still affect long-term sequestration in soils.[25] Furthermore, even if biochar were capable of being produced and used in a manner that would guarantee permanent sequestration, the biochar production process at best sequesters only a fraction of the carbon in the original biomass feedstock. The rest is typically emitted to the atmosphere as carbon dioxide (CO_2) when the syngas or bio-oil produced along with the biochar is burned. Any strategy that would rely on biochar as an end use for woody biomass would need to accurately account for these limitations in developing and assessing potential measures.

VII. Estimating the Impacts on Fire Reductions is Highly Uncertain and Speculative.

Reductions in fire extent and intensity, and thus in emissions, from forest thinning projects may be extremely hard to measure due to numerous confounding variables that also exert a great influence on fire behavior (such as temperature, humidity, wind, and precipitation). ARB will need to address these research needs and data gaps to develop an accurate accounting of the GHG impacts of all forest strategies implemented pursuant to AB 32 and SB 605. In the context of the SLCP, forest-related strategies should focus on reductions that are readily achieved, controlled and measured, rather than inherently speculative, uncertain, and expensive. Specifically, measures related to reducing SLCP emissions from agricultural burning, open pile burning, and commercial and residential cooking and fires, are likely to be much more

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[22] Concept paper at 25: "One option may be pyrolysis of woody biomass, which generates energy and biochar, and which can be used to sequester carbon in soils and improve soil fertility. Current analyses suggest that biochar could be used to sequester significant volumes of CO2 globally, but the benefits of large-scale projects have not been demonstrated or quantified, and several research gaps remain."

[23] Biofuelwatch, *Biochar: A Critical Review of Science and Policy* (Nov. 2011), *available at* www.biofuelwatch.org.uk/wp-content/uploads/Biochar-Report3.pdf.

[24] See, e.g., Michael W.I. Schmidt, et al., *Persistence of soil organic matter as an ecosystem property*, 478 Nature 49-56 (2011), doi:10.1038/nature10386.

[25] See Kurt A. Spokas, *Review of the stability of biochar in soils: predictability of O:C molar ratios*, 1 Carbon Mgmt. 289, 294 (2010).

achievable and measurable in the near-term, and perhaps much more productive in the long-term, than measures focused on influencing wild land fire behavior.[26]

VIII. We Strongly Support the Proposed Organic Waste Diversion Measures.

The only way to truly minimize fugitive methane emissions from landfills is to divert the methane-generating organic waste to other end uses. The concept paper proposes a strategy of virtually eliminating the landfill disposal of organic waste by 2025 (with an interim goal of 75% reduction by 2020). The only way to achieve these goals is to prohibit the disposal of organic waste in landfills, and we strongly support implementation of this goal.

We also support the adoption of further regulations to control the fugitive emissions from landfills. Even with a complete elimination of the disposal of organic waste, landfills will continue to generate emissions for decades to come as existing waste decomposes. Regulations could include lower surface methane concentration limits, early closure of individual landfill cells, and the implementation of advanced measurement technologies. Any measures to promote landfill gas collection from in-place organic waste must operate simultaneously with a mandate to divert all new organics away from landfills.

IX. We Strongly Support Accounting for Fugitive Methane Emissions Associated With Natural Gas.

We commend ARB for highlighting the importance of fugitive methane emissions associated with natural gas, and the possibility that accounting for the climate impacts of those emissions can result in a higher GWP for natural gas than for oil and coal.[27] We fully agree with the recognition of the need for strong national natural gas standard, given that so much of California's natural gas supply is imported into the state.[28] Furthermore, we strongly urge ARB to account for fugitive methane in cost/benefit calculations for state energy and efficiency programs.[29] To provide accurate and useful guidance in this context, such cost/benefit calculations must use the most current values for methane's global warming potential (as discussed in Section I above).

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[26] Concept paper at 25: "ARB will coordinate with local agencies and identify potential options to further reduce particulate matter and black carbon emissions from biomass burning from major sources, including wildfire, agricultural burning, open pile burning, and commercial and residential cooking and fireplaces, among others."

[27] Concept paper at 18: "Due to its high global warming potential, relatively small levels of methane emissions throughout the supply chain can overwhelm any reduction in CO2 emissions from the use of fossil or renewable natural gas, compared to oil or coal."

[28] Concept paper at 19: "However, about 90 percent of our natural gas comes from out-of-state suppliers, so the State will continue to advocate for strong national methane standards to ensure potential climate benefits from our use of gas in the State."

[29] Concept paper at 19: "In developing the Strategy, ARB and other agencies will consider whether fugitive methane emissions should be accounted for in cost/benefit calculations for various state energy and efficiency programs, and appropriate methods for potentially doing so."

X. Streamlining Permitting Must Not Compromise Environmental Review.

In the discussion of identifying practical solutions and overcoming barriers to implementation, the concept paper considers streamlining permitting as an option for facilitating and incentivizing reductions.[30] This concept should be more fully explicated and made clear that it does not involve compromising the scope or accuracy of environmental review at any level.

XI. Near-Term Emissions Goals Are Critical to Achieving Our Long-Term Climate Goals.

The concept paper identifies the goal of keeping global warming below 2°C "through 2050" or "through at least 2050."[31] This goal is certainly necessary, but it must be understood as a near-term step toward the larger goal of avoiding warming of more than 2°C throughout this century. Specifically, the concept paper cites Ramanathan and Xu (2010) and Xu et al. (2013), which clearly identify the larger goal of lowering the probability of exceeding the 2°C warming threshold during this century.[32] The Center supports the goal of keeping global warming to less than 2°C through 2050 as a generalization of the goal to achieve substantial reductions in the near term in order to achieve the goal of not exceeding the 2°C warming threshold during this century, and in the context of the overarching goal of reducing global warming-inducing pollution as much as possible, as quickly as possible.

Also, the targets for methane and F-gases are expressed in the concept paper as reductions "below forecasted emissions levels."[33] Specifying the "forecasted" levels is critical in determining the adequacy of those reductions targets and assessing options for achieving those reductions. These targets either need to be defined in terms of specific forecasted levels, or described in terms of specific reductions, as were the targets for black carbon.[34]

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[30] Concept paper at 14: "Through coordinated planning to align priorities and streamline permitting, targeted investment and incentives to overcome cost barriers to clean technologies and practices, and direct engagement with farmers and ranchers, landfill operators, waste haulers, and other stakeholders, we can overcome these barriers and significantly cut SLCP emissions and improve the health and vibrancy of communities throughout California."

[31] Concept paper at 1: "In his 2015 Inaugural Address, Governor Brown reinforced this commitment and called on California to show the world the path to limiting global warming below 2º C through 2050, while highlighting the role that action to cut SLCPs must play in this effort." Concept paper at 4: "Achieving these levels of global reductions would deliver significant climate benefits... It would also increase the probability of staying below the 2º C threshold to more than 90 percent through 2050."

[32] Xu *et al*., 2013: "This combined mitigation of SLCPs would cut the cumulative warming since 2005 by 50 % at 2050 and by 60 % at 2100 from the CO2-only mitigation scenarios, significantly reducing the rate of warming and lowering the probability of exceeding the 2 ◦C warming threshold during this century." Ramanathan and Xu, 2010, at 8061: "If enough CO2, methane, and BC can be removed from the air, beginning in 2050, to reduce the energy addition by 0.1 Wm−2 each, the probability of exceeding 2 °C by 2100 will be smaller than 15% compared with the 50% probability for the FMA case."

[33] Concept paper at 13: "Specifically, the Strategy will... Identify existing and potential new measures to reduce methane emissions by at least 20 percent by 2020 and 40 percent by 2030, below forecasted emission levels; and Identify existing and potential new measures to reduce F-gas emissions by at least 25 percent in 2020 and 50 percent in 2030, below forecasted emission levels."

[34] Concept paper at 13: "Specifically, the Strategy will: Describe ongoing and developing efforts (e.g., Sustainable Freight Strategy, Diesel Risk Reduction Plan, State Implementation Plan, Forest Carbon Plan) that have achieved

Conclusion

Thank you for your consideration of these comments. We strongly support the development of these measures to address short-lived climate pollutants, and we look forward to working with you on this important issue. Please contact me if you have any questions about these comments.

Sincerely,

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significant black carbon reductions already or seek to reduce black carbon emissions further; these efforts and others that will be identified, are expected to reduce black carbon emissions by at least 50 percent below 2012 levels from transportation sources by 2020, and from all sources by 2030..."