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Comment on Land Management Plan Directionfor Old-Growth Forest Conditions Across theNational Forest System #65356Greg KochanskiGoals in the Executive OrderIn Executive Order 14072 (Biden 2022), President Biden wrote (boldface mine)My Administration will manage forests on Federal lands, which include many mature andold-growth forests, to promote their continued health and resilience; retain and enhancecarbon storage; conserve biodiversity; mitigate the risk of wildfires; enhance climateresilience; enable subsistence and cultural uses; provide outdoor recreationalopportunities; and promote sustainable local economic development.[hellip](c) Following completion of the inventory, the Secretaries shall:[hellip](iii) develop policies, with robust opportunity for public comment, toinstitutionalize climate-smart management and conservation strategiesthat address threats to mature and old-growth forests on Federal lands.It's clear from the text of the Executive Order that the phrase "climate smart"includes the idea that one of the goals of forest management should be to maximizecarbon storage, amongst other goals. This is consistent with the Forest Service'sMission Statement,"The mission of the USDA Forest Service is to sustain the health, diversity, andproductivity of the Nation's forests and grasslands to meet the needs of presentand future generations." (USDA 2015)where it is important to both present and future generations that we slow climatechange by removing as much carbon dioxide as possible from the atmosphere.Forest Management for Carbon OptimizationAnd that brings us to [sect]7.4.2 Forest Management for Carbon Optimization, inthe DRAFT Ecological Impacts Analysis Report. The report does not account forthe time it takes a forest, especially an old-growth forest to re-grow after it isharvested. It states:Many management activities may have short-term carbon emissions butyield long-term carbon benefits through enhancing forest resiliency andtherefore carbon stabilization. For example, timber harvest aimed atremoving hazardous fuels and reducing live tree density can yieldshort-term carbon emissions but ultimately reduce risk of high severitywildfire, yielding long-term increases to carbon stability (Krofcheck etal. 2019).While this is literally correct, the words "ultimately" and "long-term" are misleading,because it takes decades to centuries for the forest to re-grow. When the forest isharvested CO2 is generated and a carbon debt is created. During the payback period,the atmosphere and ocean will have a higher CO2 concentration and will thus trapmore solar energy and raise the Earth's temperature. As the forest grows back, it willreduce that CO2 debt, but the temperature increase will remain for a long time in theform of warmer ocean water. This logic is supported by the literature, e.g. in (O'Hare2009) and (Peng 2023).The concept of a carbon debt and payback period is standard in the literature, thoughit is perhaps more often associated with construction projects like wind farms or solarpanels, e.g. (NREL 2024), than with forestry. As an example of the use of theseconcepts in the forest-adjacent literature, (Malcolm et al 2020) describe thecomputation of a payback period for forest harvest for wood pellets for electricitygeneration.A second statement in [sect]7.4.2 that is true but misleading is this:For projects involving forest harvest, some removed carbon can be stored forlong time periods if converted to harvested wood products (HWP).Certainly, a fraction of harvested wood will be used for building houses and the like,and will be stored for perhaps as long as a century. Other wood products like paperand cardboard end up in landfills within a decade, at which point its global warmingpotential is largely determined by how well the landfill's methane production ismanaged and collected. But a lot of wood is just burned for fuel. A surprisingamount of American wood is burned overseas (Chatham House 2017).Figure 2 in (Peng 2023) shows a flowchart of roundwood use in 2010, and we see that48% (1.9 billion m3/year) is burned for fuel, and 18% (0.63 billion m3/year) becomes"industrial waste". A further 9% becomes paper and presumably ends up in a landfillwithin a few years. The remaining 25% becomes lumber, fiberboard, etc and has achance of a long lifetime.Evaluating the lifespan of harvested wood products is complicated, and detailedmodeling is necessary to extract precise answers. However, it's clear that part of theharvest turns into CO2 fairly rapidly. And, typically fossil fuels are used for processingand shipping the wood, adding a bit more CO2.The final problematic statement in [sect]7.4.2 is:Woody biomass for energy production can also decrease greenhouse gasemissions if it is substituted for more fossil fuel-intensive energy sources(Sathre and O'Connor 2010, D'Amato et al. 2011, Oliver et al. 2014).As before, the statement is -- strictly speaking -- correct, but misleading. It'smisleading because coal and gas are no longer the dominant power sources for newelectrical generation. Specifically, September 2024 statistics from the US EnergyInformation Administration show that wind, solar, and battery added 18.7 GW of newcapacity, while only 0.4 GW of fossil gas powered generators were added (EIA 2024).Including forecasts for the remainder of 2024, 94% of new generation capacity will berenewables, while only 4% of new generation capacity is powered by fossil fuels.So, we should be comparing the carbon intensity of burning wood to the averagecarbon intensity of new generation capacity. And, while electrical power generatedfrom wood may have a smaller carbon footprint than generation from gas, its carbonfootprint is higher than an average modern power plant. Estimates of the carbonintensity of wood-burning power plants are available for the Drax plant in the UK(which incidentally gets much of its wood pellets from the USA). A Chatham Housereport (Brack et al 2017 [sect]3.5) finds that the carbon footprint of the wood pelletsupply chain is 19% - 44% of the CO2 emitted by burning the pellets. So, wood fueledpower plants are now dirtier than new US power generation, even neglecting theburning of the wood itself.So far, we have established three points. First, that Forest Service policies should(amongst other goals) attempt to maximize carbon storage. Second, when trees areharvested, CO2 is released into the atmosphere, and global warming is accelerateduntil the forest regrows and pays back the carbon debt. And third, the magnitude ofthe carbon debt is a substantial fraction of the carbon in the forest. (Peng 2023)shows that the global carbon footprint of forest harvests is 3-4 gigatons ofCO2-equivalent per year.Appropriate ActionsSo, what are the appropriate actions to take that would increase the amount ofstored carbon and thereby minimize global warming? To do this, one maximizes thecarbon stored in the three main reservoirs:1. The forest itself, including trees, roots, soil carbon, and downed wood;2. Long-lived wood products with lifetimes of at least several decades (e.g.houses);3. Short-lived wood products (e.g. paper) which have reached well-maintainedlandfills where methane emissions are controlled and the wood products areexpected to survive for a time comparable to or larger than the forest regrowthtime.Basically, if some forest carbon isn't stored in #1, #2, or #3, it will be in theatmosphere.While we cannot dismiss #2 and #3, Figure 2 in (Peng 2023) makes it clear that when aforest is harvested, these reservoirs end up with only a small fraction of the wood. Ahouse, for instance, would primarily be built from sawn wood (10.4% of harvestedroundwood), wood based panels (7.9% of harvested roundwood), and poles, pilings etc(3.3% of harvested roundwood). In total, reservoir #2 will accumulate no more than21.6% of harvested roundwood. And, of course the roundwood is only a part of thetotal forest: roundwood is basically the vertical tree trunks, leaving out branches.Similarly for #3. Paper is probably the largest landfill component, and it comprises20.4% of the harvested roundwood; "industrial waste" is another 17.5%. However, it'snot reasonable to consider landfills to be stable storage reservoirs of carbon: theEnvironmental Protection Agency estimates landfills account for 14% of the USmethane emissions (US EPA 2024), and methane is an important greenhouse gas.Even optimistically, only a modest fraction of the harvested wood will be stored safelyfor the time it takes for the forest to re-grow, and the USFS has relatively littlecontrol over that fraction. So, the handle that the USFS has to control stored carbonis to control the amount of carbon in the forest (i.e. #1 above).It is well established that the carbon stored in forests increases with the age of theforest, even well into the "old growth" stage (Keeton et al 2011; Moomaw et al 2019;Fraser et al 2023). (Luyssaert et al 2008), (Gundersen 2021), and (Luyssaert 2021)disagree on the rate at which old-growth forests store carbon, but both agree thatold-growth forests continue to capture substantial amounts of carbon.Carbon keeps accumulating as forests age, so old growth forests store the largestamount of carbon. Consequently, if we were managing just for maximum carbonstorage, we should manage to increase the amount of healthy old-growth forest.In a real situation, where forests face threats from fire, pests, and disease, and wheretimber production is another goal, the best overall management strategy is going tobe a blend of the strategies that are separately optimized for timber production, andcarbon capture. However, the optimum blend will put more emphasis on old-growthforests than a strategy that ignores carbon capture.Specifically, because the DRAFT Ecological Impacts Analysis Report dismisses carboncapture in forests, any management strategy that has carbon capture as a goal willinclude more mature and old-growth forests than the preferred plan proposed in LandManagement Plan Direction for Old-Growth Forest Conditions Across the NationalForest System #65356. Thus, we should prefer Alternative 3 because it will lead totrees standing longer, giving them more time to store carbon, and increasing the totalstored carbon.To quote (Peng

2023), "These findings are, in a sense, good news because they implythat if people could reduce forest harvests, forest growth could do more to reduceatmospheric carbon, a potential mitigation 'wedge' that is rarely identified in climatestrategies."Summary- Carbon storage is explicitly listed as a goal in Executive Order 14072.- The analysis in [sect]7.4.2 of the DRAFT Ecological Impacts Analysis Report isincomplete because it waves away the extra global warming caused by thereduction in carbon storage that happens when trees are harvested.- Storage of forest carbon in manufactured wood products is not negligible, butis substantially smaller than carbon storage in the forest itself.- Forests continue to accumulate carbon far into the "old growth" regime. Forpractical purposes, the older a patch of forest is, the more carbon it stores.- Therefore any forest management plan that has carbon storage as a goal shouldminimize harvesting, and especially minimize harvesting of mature andold-growth areas. (Subject to potential compromises with other goals.)- Because the flawed analysis in [sect]7.4.2 of the DRAFT Ecological ImpactsAnalysis Report leads to Alternative 2, an analysis that includes carbonstorage as a goal would likely lead to a strategy like Alternative 3.References-William S. Keeton, Andrew A. Whitman, Gregory C. McGee, Christine L.Goodale; Late-Successional Biomass Development in NorthernHardwood-Conifer Forests of the Northeastern United States; Forest Science,Volume 57, Issue 6, December 2011, Pages 489-505,https://doi.org/10.1093/forestscience/57.6.489;- William R. Moomaw, Susan A. Masino, and Edward K. Faison; Intact Forests inthe United States: Proforestation Mitigates Climate Change and Serves theGreatest Good; Front. 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Reply to: Old-growth forest carbon sinks overestimated. Nature,591(7851), E24-E25. https://doi.org/10.1038/s41586-021-03267-y- USDA Forest Service Strategic Plan: FY 2015-2020; Forest Service FS-1045 June2015;https://www.fs.usda.gov/sites/default/files/strategic-plan[2]-6_17_15_revised.pdf; viewed 9/2024.ATTACHMENT: USFS response 2024-09.pdf- this is the same content that is coded in text box, it was also included as an attachment