



Accounting for Climate-Related Risks In Federal Forest-Management Decisions

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A. Summary

Actions that reduce the amount of carbon stored in federal forests contribute to disruption of the global climate by increasing atmospheric concentrations of carbon dioxide. The climate disruption raises the risk of economic harm – locally, nationally, and globally – from extreme weather events, higher temperatures, changes in precipitation, rising sea levels, acidification of oceans, and changes in ecosystems. Laws and executive orders require managers of federal forests to account for these risks. This paper describes the recent failure of the Bureau of Land Management (BLM), to satisfy the requirements. It also describes the steps the BLM must take to meet its obligations, and illustrates the method the BLM and other federal forest-management agencies should use to account for carbon-related risks in the future.

The BLM failed to account for climate-related risks when it selected its Preferred Alternative for managing federal forests in western Oregon. If implemented, this alternative would yield more timber but less forest carbon than another alternative. Using old data and a conservative view of risk, the BLM provided information that indicates the additional climate-related costs may:

- *Outweigh the additional timber-related benefits by 2-to-1.*
- *Equal \$91,000 per additional timber-related job.*
- *Equal \$4 for every \$1 of additional timber-related payments to local counties.*

Current data, plus a widely accepted view of risk indicates the additional climate-related costs may:

- *Outweigh the additional timber-related benefits by more than 30-to-1.*
- *Equal \$1.6 million per additional timber-related job.*
- *Equal \$68 for every \$1 of additional timber-related payments to local counties.*

The BLM disregarded this information when choosing its Preferred Alternative. To satisfy its legal and administrative requirements, the BLM should fully and clearly describe the climate-related risks that accompany the Preferred Alternative, and explain its justification for imposing these risks on the individuals, households, businesses, and communities that would bear them. This justification should address both the reduction in overall economic wellbeing that would result from implementing the Preferred Alternative and the moral issues that arise from imposing climate-related risk on those that would not enjoy the timber benefits.

B. Forest Managers Are Required to Account for Climate-Related Risks in Their Forest-Management Decisions

Forest managers have statutory and administrative requirements to account for the climate-related risks of their actions:

National Environmental Policy Act (NEPA)

- Federal agencies "to the fullest extent possible" must provide a detailed EIS (42 U.S.C. 4332). In applying this standard, courts have held that, at a minimum, NEPA imposes on an agency a duty to take a "hard look at environmental consequences" (Natural Resources Defense Council v. Morton, 458 F.2d 827, 838 (D.C. Cir., 1972)).
- NEPA also imposes on the agency a "requirement of a substantial, good faith effort at studying, analyzing, and expressing the environmental issues in the EIS and the decisionmaking process" (Natural Resources Defense Council v. Morton, 458 F.2d 827, 838 (D.C. Cir., 1972)).
- A sufficient EIS must provide good faith analysis and sufficient information to allow a firm basis for weighing the risks and benefits of a proposed action (County of Suffolk v. Secretary of the Interior, 562 F.2d 1368 (2nd Cir. 1977), cert. denied, 434 U.S. 1064 (1978)).

Executive Order 13656: Preparing the United States for the Impacts of Climate Change

- "[A]gencies should promote...risk-informed decision-making and the tools to facilitate it."
- "[R]ecognizing the many benefits the Nation's natural infrastructure provides, agencies shall, where possible, focus on program and policy adjustments that promote the dual goals of greater climate resilience and carbon sequestration."

Principles and Requirements for Federal Investments in Water Resources

- "It is intended that these Principles and the supporting Requirements and Guidelines be applied to a broad range of Federal investments that by purpose, either directly or indirectly, affect water quality or water quantity, including ecosystem restoration or land management activities."
- "Evaluation methods should be designed to ensure that potential Federal investments in water resources are justified by public benefits, particularly in comparison to costs associated with those investments. Such methods should apply an ecosystem services approach.... Services and effects of potential interest in water resource evaluations could include, but are not limited to...carbon storage."
- "When analyzing potential investments in water resources, areas of risk and uncertainty should be identified, described, and considered."
- "Risks and uncertainties should be identified and described in a manner that is clear and understandable to the public and decision makers. ... The advantages and costs of reducing risk and uncertainty should be explicitly considered in both the formulating of alternatives, and in the overall decision making process."
- "Any recommendation for Federal investments in water resources to address identified water resources needs must be justified by the public benefits when compared to costs."

C. Reductions in Forest Carbon Create Risks of Climate-Related Economic Harm

Research demonstrates that logging reduces the amount of carbon stored in federal forests and increases the amount of carbon dioxide in the atmosphere.¹ Increases in atmospheric carbon dioxide disrupt the global climate, raising the risk of economic harm from extreme weather events, higher temperatures, changes in precipitation, rising sea levels, acidification of oceans, and changes in ecosystems.²

An Interagency Working Group of federal agencies recently provided estimates of the economic harm per metric ton expected to result from incremental increases in atmospheric CO₂ in future years.³ This harm is called the social cost of carbon. The estimates are intended to measure potential climate-related damage, such as reductions in net agricultural productivity from droughts, adverse impacts of heat waves on human health, destruction of property by floods, and the loss of ecosystem services.

The estimates are incomplete, however, because the 2012 literature does not cover all types of economic harm from atmospheric carbon dioxide.⁴ The Interagency Working Group recommended that analysts recognize the incompleteness of its estimates. It also partially addressed the uncertainty in the available literature by providing four sets of estimates. Three of these represent the average expected economic harm per ton of emissions under different assumptions about the applicable discount rate for weighing costs that would occur in different years. The core set of these estimates uses a discount rate of 3 percent per year. The fourth set of estimates uses the same discount rate but, instead of considering the average expected costs, it considers the costs at the 95th percentile of the expected range of costs. These estimates represent a widely accepted approach for considering high-risk potential outcomes.

The core set of estimates shows, for example, that the average expected social cost, in 2007 dollars, for a ton of carbon dioxide emitted in 2015 is \$37. The corresponding expected cost at the 95th percentile of expectations is \$109 per ton. The models underlying these numbers indicate that the U.S. will bear 10–23 percent of the overall global costs from emissions of carbon dioxide into the atmosphere.

The Interagency Working Group understood that its estimates of the social cost of carbon are provisional and require further refinement as understanding of the underlying scientific, economic, and ethical issues evolves. One important step in this evolution materialized in January with publication of results from a study by researchers at Stanford University.⁵ They recognized that the storms, droughts, etc. from changes in climate will do more than just generate economic harm directly, by destroying property, reducing crops, etc. These impacts also will reduce the global economy's ability to grow. The researchers found that accounting for this effect increases the Interagency Working Group's estimates of the social cost of carbon by a factor of six.

D. Risk-Informed Decision-Making: The BLM Demonstrates How Not To Do It, but Has an Opportunity to Do It Correctly

The BLM recently released its *Draft Resource Management Plan/Environmental Impact Statement (DRMP/EIS)* for 2.5 million acres of lands, most of which are forested, in western Oregon.⁶ In the document, the BLM describes several alternatives and presents Alternative B as its Preferred Alternative, notably rejecting Alternative D. The primary, quantified difference between the

two is that Alternative B would produce more timber but less carbon stored in the limbs, trunks, and roots of the forest’s trees.

The legal and administrative requirements described above dictate that, before selecting Alternative B, rather than Alternative D, as its Preferred Alternative, the BLM was required to account fully for the additional climate-related risks associated with Alternative B. The *DRMP/EIS* should have described the risks in a manner that is clear and understandable to the public and decision makers. The decision-making process the BLM used to select Alternative B as its Preferred Alternative should have weighed the climate-related risks against the potential benefits and demonstrated that its decision has a firm, risk-informed foundation.

The BLM failed to satisfy these requirements. To correct this deficiency, it must weigh the additional climate-related risks of Alternative B against the additional timber-related benefits. With the information readily available to it, the BLM should have weighed the risks of Alternative B against its benefits in these steps:

1. Weigh the (average) expected climate risks against the timber benefits.

The *DRMP/EIS* estimates the annual value of timber production under each alternative and uses the (average) core set of estimates of the social cost of carbon from the Interagency Working Group to estimate the total value of carbon that would be stored annually. These numbers indicate that Alternative B has these additional risks and benefits:

Additional Timber Benefits	Additional Climate Risks (Average)	Risk-Benefit Ratio
\$36 mil.	\$68 mil.	2

2. Account for risks not included in the Interagency Working Group’s estimates of the social cost of carbon.

Moore and Diaz (2015) found that accounting for the impacts of climate on economic growth increases the Interagency Working Group’s estimates of the social cost of carbon by a factor of six. Making this adjustment results in this weighing of Alternative B’s (average) expected climate risks against its benefits:

Additional Timber Benefits	Additional Climate Risk (Average, Adjusted for Economic-Growth Costs)	Risk-Benefit Ratio
\$36 mil.	\$410 mil.	12

The BLM also should search the current professional literature to determine if it supports other adjustments to the social cost of carbon.

3. Account for the possibility that the climate-related risks of Alternative B will be higher than those indicated by the Interagency Working Group’s average estimates of the social cost of carbon.

The expectations reported by the Interagency Working Group suggest that the costs at the 95th percentile will be about 3 times the average expectations. Making this adjustment yields this weighing of the risk and benefits:

Additional Timber Benefits	Additional Climate Risk (Adjusted for Economic-Growth Costs, 95 th Percentile)	Risk-Benefit Ratio
\$36 mil.	\$1,200 mil.	34

4. Describe other indicators of the climate-related risks.

The BLM has indicated its desire to manage federal forest land in western Oregon to generate jobs and timber-related revenues for local counties. Using information in the *DRMP/EIS* and taking analytical steps analogous to those described above suggest that implementing the Preferred Alternative would generate risks insofar as the potential climate-related costs would outweigh these desired outcomes.

	Climate-Related Cost per Job
Average climate risks (Interagency Working Group)	\$91,000
Adjusted for economic-growth costs not addressed by Interagency Working Group (Moore and Diaz 2015)	\$550,000
Adjusted for economic-growth costs, 95 th percentile of expected risks	\$1,600,000

	Climate-Related Cost per \$1 Payment to Counties (2018)
Average climate risks (Interagency Working Group)	\$4
Adjusted for economic-growth costs not addressed by Interagency Working Group (Moore and Diaz 2015)	\$23
Adjusted for economic-growth costs, 95 th percentile of expected risks	\$68

5. Clearly explain the risk implications of the decision to select Alternative B as its Preferred Alternative.

After clearly showing this information on risks and benefits, the BLM should explicitly explain the risk implications of its selection of Alternative B as the Preferred Alternative.

- **Describe the risks in a manner that is clear and understandable to the public and decision-makers.**

The BLM should draw on the relevant literature to help the public and decision-makers understand how the potential costs might materialize. It should describe, for example, the likelihood that, relative to Alternative D, Alternative B would increase the risk of mortality and morbidity from more frequent heat waves, reduce agricultural productivity from more frequent and severe droughts, or increase the levels and acidity of the seas. This effort should begin by drawing on examples in the *National Climate Assessment*. It also should draw examples from an assessment of

different types of risks carbon-dioxide emissions pose to the households, businesses and communities of Oregon.⁷ The latter used data from 2009 to determine that, absent meaningful actions to reduce the emissions of carbon dioxide, annual climate-related costs would average about \$2,000 per household by 2020.

- **Describe those who would bear the climate-related risks.**

The BLM should make clear to the public and decision-makers that every household, business, and community – in Oregon and elsewhere – would bear some exposure to the climate-related risks that would accompany implementation of Alternative B rather than Alternative D. It should, for example, state clearly that Americans will bear some of the climate-related risks. It should explain that the models underlying the Interagency Working Group’s estimates of the social cost of carbon indicate that the U.S. would bear 10–23 percent of the total.

- **Clearly explain its justification for imposing these risks on households, businesses, and communities.**

The BLM should explicitly explain why it considers the additional timber benefits of Alternative B to be sufficiently important that it has decided to impose, on Oregonians and others, climate-related costs that may exceed \$30, for every \$1 of timber benefits. The explanation should explicitly address the economic concerns, e.g., the reduction in overall economic wellbeing that would result insofar as implementation of Alternative B would lead to climate-related costs that exceed the timber benefits. It also should explicitly address the moral issues that arise insofar as those who would bear the climate-related risks are not the same as those who would enjoy the timber benefits.

E. Conclusions

The Bureau of Land Management, U.S. Forest Service, and other federal forest-management agencies have legal and administrative obligations to account for and clearly disclose the climate-related risks of the timber-harvest and other activities that reduce the amount of carbon stored on their lands. These obligations will become more imperative as human-caused disruption of the climate becomes more severe and the likelihood of catastrophic outcomes increases. This paper illustrates that the BLM has failed to satisfy these obligations in its *Draft Resource Management Plan/Environmental Impact Statement (DRMP/EIS)* for 2.5 million acres of lands primarily located in Oregon. It also offers a method that federal agencies can use to satisfy their obligations in the future.

F. Methodological Summary

The *DRMP/EIS* estimates the metric tons of carbon stored per year, on average, for each alternative. It then multiplies the amount times the value per ton, derived from the average social cost of carbon reported by the Interagency Working Group (3 percent discount rate), to estimate the total value of the increase in stored carbon per year (p. 526). It also estimates the annual value of timber production.

	Carbon Storage Value per year	Timber Value per year
Alternative B	\$165.0 million	\$72.9 million
Alternative D	\$232.8 million	\$37.4 million
Difference (B-D)	-\$67.8 million	\$35.5 million

The difference, derived by subtracting the values for Alternative D from the value for Alternative B, represents the value of the carbon not stored under Alternative D and, hence, represents a lower-bound estimate of the climate-related risks, i.e., the additional climate-related costs, of the Preferred Alternative. The difference for timber values represents the additional timber-related benefits of Alternative B.

Dividing the additional climate-related cost by the additional timber value yields the cost-to-benefit ratio. Each ratio reflects the out-of-date data underlying the Interagency Working Group's estimates of the average expected social cost of carbon.

The next step entails adjusting to account for data that have become available since the Interagency Working Group published its estimates of the social cost of carbon. One important cost the Interagency Working Group did not consider is the impact of extreme weather events, etc. on economic growth. Moore and Diaz (2015) conclude that accounting for the impacts of climate change on economic growth increases the Interagency Working Group's estimates of the social cost of carbon by a factor of six.

The next step entails adjusting to account for the possibility that actual costs will materialize at the upper end of the distribution of estimates rather than at the average. The BLM reports that the expected social cost of carbon at the 95th percentile of the range of estimates (3 percent discount rate) is about three times the average.

Extending the analysis to consider the relationship between risk and the impacts on jobs and timber-related payments to counties can provide information that might be useful for helping the public and decision-makers weigh the risks of actions that diminish forest carbon against the timber benefits. The *DRMP/EIS* shows jobs estimates on p. 547, and payments to counties in 2018 on p 563.

	Timber Jobs	Payments to Counties
Alternative B	1,827	\$36.4 million
Alternative D	1,083	\$18.7 million
Difference (B-D)	744	\$17.7 million

¹ Sonne, Edie. 2006. "Greenhouse Gas Emissions from Forestry Operations: A Life Cycle Assessment." *Journal of Environmental Quality*. 35:1439-1450.

² U.S. Global Change Research program. 2014. *National Climate Assessment*.
<http://nca2014.globalchange.gov/downloads>.

³ Interagency Working Group on Social Cost of Carbon, United States Government. 2013. "Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866." May.

⁴ Revesz, R.L., P.H. Howard, K. Arrow, L.H. Goulder, R.E. Kropp, M.A. Livermore, M. Oppenheimer, and T. Sterner. 2014. "Global Warming: Improve Economic Models of Climate Change." *Nature*. April 4.

<http://www.nature.com/news/global-warming-improve-economic-models-of-climate-change-1.14991>.

⁵ Moore, Frances, C., and Delavane B. Diaz. 2015. "Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy." *Nature Climate Change*. 12 January.

<http://www.nature.com/nclimate/journal/v5/n2/full/nclimate2481.html>.

⁶ <http://www.blm.gov/or/plans/rmpswesternoregon/deis.php>.

⁷ Niemi, E., and members of the Program on Economics' Steering Committee. 2009. *An Overview of Potential Economic Costs to Oregon of a Business-As-Usual Approach to Climate Change*. Climate Leadership Initiative, Institute for a Sustainable Environment, University of Oregon. February 17.