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Employment Effects of Investments in Public and Working Lands

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INTRODUCTION

America's public and working lands, including farms, forests and rangelands, play an important role in mitigating greenhouse gas emissions through their capacity to sequester and store carbon in forests and soils. Public and working lands' contribution to climate change solutions, as well as other values such as wildlife habitat and the provision of clean and abundant water supplies, may be at risk due to changes in land use and the impacts of climate-driven severe weather events such as drought and wildfire. . Changes in land use are an important determinant of the scale of emissions sources and sinks in the U.S. According to an analysis by the U.S. Environmental Protection Agency (EPA), total carbon sequestration in the land use and forestry sectors decreased by approximately 12.4 percent between 1990 and 2019.[1] Both wildfire and land use change are key contributors to alterations in the carbon sequestration capacity of America's public and working lands, a category which includes private land as well as land managed by the federal government.

In light of these concerns, members of Congress and others have put forth various policy proposals specific to the management of public and working lands to provide climate benefits alongside their traditional supply of food, fiber, wood products, and ecological services. Many of these policies involve changes in forest management while others focus on changing or enhancing farming practices. In addition, while some policies focus on the management of federal land, others provide incentives or assistance for private landowners to modify their land management practices.

The purpose of this document is to assess the stimulative effect of several such policies. Specifically, we estimate the employment, GDP, and income impacts of seven public and working lands policies designed to mitigate carbon emissions while simultaneously stimulating the economy. In the sections that follow, we outline each of the polices that we examine, describe our approach for estimating the economic impacts of these policies, and present the results of our analysis.

POLICIES EXAMINED

The public and working lands policies examined in this analysis include several initiatives that represent an expansion of existing programs managed by the U.S. Department of Agriculture or other federal agencies, as well as policies based on existing proposals. These policies include the following:

- ***Increased funding for wildland firefighters:*** To help prevent the spread of wildfires and the release of sequestered carbon from forest stands, this policy would fund the hiring, training, and deployment of wildland firefighters. Wildfire is a natural part of many ecosystems. An expanded workforce of wildland firefighters would not prevent all fires from occurring; however, it could enhance

[1] Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019. Available at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019

interagency response capabilities and allow for more effective containment of wildfires, preventing many of the undesirable consequences of uncharacteristically severe wildfire events, including carbon emissions, soil erosion and other impacts that alter forest ecosystems.[2] .

- ***Federal forest thinning:*** Under this policy, the U.S. Forest Service would expand its hazardous fuels management thinning activities on National Forest lands with significant wildfire risk. Strategically targeted thinning would reduce the amount of fuel available to wildfires, helping to prevent or slow the spread of these fires when they occur.[3]
- ***Federal forest replanting:*** This policy would increase the pace of forest restoration and investment in active forest management on public lands managed by the U.S. Forest Service. These investments would increase forest health and resilience to threats including wildfire and climate change.[4]
- ***Tree planting on marginal lands:*** Through expansion of the USDA Conservation Reserve Program, this policy would increase incentive payments to encourage private landowners to plant trees and restore forests. The tree stands developed under this initiative would expand the sequestration of carbon on private lands across the U.S.[5]
- ***Cover cropping:*** This policy would fund the planting of cover crops on existing farmland. While these crops would not be harvested for sale, they would sequester carbon and improve soil health through aeration, erosion reduction, and serving as feed for organisms that accumulate soil nutrients.
- ***Grassland restoration on marginal lands:*** This policy would also expand the USDA Conservation Reserve Program through additional funding focused on the restoration of grasslands on privately owned lands. This restoration would prevent soil erosion and facilitate carbon sequestration.[6]

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[2] Note that in addition to efforts by the U.S. Forest Service, the Department of the Interior (DOI) also funds a share of federal wildland firefighting. From 2011-2020, the USFS accounted for 78 percent of wildfire appropriations, while DOI accounted for the remaining 22 percent. See Congressional Research Service (2020). "Federal Wildfire Management: Ten-Year Funding Trends and Issues (FY2011-FY2020)." Available at: https://fas.org/sgp/crs/misc/R46583.pdf

[3] As with wildland firefighting, DOI funds a share of federal hazardous fuels management practices, in addition to appropriations through the U.S. Forest Service. In 2020, the USFS accounted for 70 percent of hazardous fuels management appropriations, while DOI accounted for the remaining 30 percent. See Congressional Research Service (2020), *op cit*.

[4] While this proposed policy only considers replanting programs on U.S. Forest Service lands, the Department of the Interior and the Bureau of Land Management also carry out tree planting initiatives.

[5] While this proposed policy considers the expansion of the Conservation Reserve Program, this proposal could also be implemented through other programs, such as the Environmental Quality Improvement Program. Because this analysis makes use of cost sharing ratios specific to the Conservation Reserve Program, consideration of a different program's expansion could affect the magnitude of the resulting employment estimates if total spending were to change.

[6] While this proposed policy is quite similar to the proposal for tree planting on marginal lands, the expected spatial distribution for the two policies is different, as indicated in Exhibit 1.

- ***Installation of anaerobic digesters:*** To help reduce methane emissions from livestock, this policy would fund the installation of anaerobic digesters for the recovery of biogas from livestock manure. The biogas can be used for electricity production used onsite, potentially resulting in additional greenhouse gas reductions, as it would reduce the need to purchase power produced offsite from more emissions-intensive sources.

Exhibit 1 summarizes the funding level and timeline for each of these policies. The dollar amounts specified for individual policies are in line with existing policy proposals, and the time horizons chosen reflect near-term stimulus spending that would occur within the next five years.

APPROACH

To assess the economic impacts of these policies, we applied the *Status* input-output model developed and maintained by Inforum, an economic research organization affiliated with the University of Maryland. Input-output models are a well-established framework for assessing the economic impacts associated with a change in expenditures for one or several industries across multiple sectors of the economy. Using detailed data on inter-industry relationships, input-output models estimate how a positive or negative shock in one industry (e.g., a change in output) cascades across the broader economy. Thus, in addition to capturing direct economic impacts for industries with increased (or decreased) production, input-output models capture spillover effects to other industries. These spillover effects include indirect impacts and induced impacts. Indirect impacts reflect inter-industry purchases and arise from firms purchasing inputs from their suppliers. For example, in the context of expenditures on anaerobic digesters, indirect impacts would include the employment associated with manufacturing the piping included in digester systems. Induced impacts, by contrast, result from wages paid to workers, who may spend these wages on consumer electronics, clothing, etc. Again, in the context of expenditures on anaerobic digesters, induced effects include the employment impacts associated with installation workers spending their earnings.

The *Status* input-output model used for this analysis is based on the industry and commodity database maintained by Inforum based on data published by the U.S. Bureau of Economic Analysis and other U.S. government agencies. The model has 121 commodity sectors and 71 industry sectors, classified according to the 2012 North American Industry Classification System (NAICS). The input-output framework on which *Status* is built contains annual data in both current and constant prices, from 1997 to 2019. Projections of the database after 2019 are obtained from a standard projection of Inforum's sectoral and commodity database, which includes projections of changes in input-output coefficients over time. The *Status* model has been used in multiple analyses for federal agencies, including an assessment of domestic output and jobs related to agricultural exports and imports (for the U.S. Department of Agriculture's Economic Research Service) and analysis of the direct and indirect components of health care supply (for the Center for Medicare and Medicaid Services).

EXHIBIT 1. DESCRIPTION OF PUBLIC AND WORKING LANDS POLICIES EXAMINED

POLICY TYPE	POLICY NAME	POLICY DESCRIPTION	TOTAL FUNDING LEVEL	TIMELINE OF EXPENDITURES
Federal Lands Management	Increase funding for USFS wildland firefighters	This policy would fund the hiring, training, and deployment of additional wildland firefighters within the U.S. Forest Service.	$1 billion in federal outlays	Funding uniformly distributed over a 2-year period.
	Federal forest thinning	This policy would fund hazardous fuels management thinning activities on National Forest land with significant wildfire risk.	$1 billion in federal outlays	Funding uniformly distributed over a 5-year period.
	Federal forest replanting	This policy would fund forest replanting on National Forest land where there have been recent wildfires.	$500 million in federal outlays	Funding uniformly distributed over a 5-year period.
Incentives to Private Landowners	Forestry – tree planting on marginal lands not used for production	This policy would expand funding for the USDA's Conservation Reserve Program (CRP) to finance tree planning on marginal lands mostly not used for crop or livestock production. The expanded program funding would cover rental payments to landowners as well as cost share assistance for the planting and establishment of trees.	$500 million in federal outlays, ~$341.7 million modeled as net rental payments to landowners and ~$158.3 million for planting activities.[1]	Rental payments are spread evenly over a five-year time horizon. Expenditures on planting spread evenly over the first two years.
	Agriculture – cover crop development	This policy would expand the USDA's Environmental Quality Incentives Program (EQIP) funding for cover crop incentives paid to U.S. farmers.	$500 million in federal outlays.	Funding uniformly distributed over a 5-year period.
	Grassland restoration	This policy would expand funding for the USDA CRP to support the establishment and maintenance of grasslands on agricultural land.	$500 million in federal outlays, ~$341.7 million modeled as net rental payments to landowners and ~$158.3 million for planting activities.[1]	Rental payments are spread evenly over a five-year time horizon. Expenditures on planting spread evenly over the first two years.
	Anaerobic digesters	This policy would fund the installation of anaerobic digesters to capture methane emissions from livestock.	$250 million in grants.	Funding uniformly distributed over a 5-year period.

Notes:
1. Based on the mix of rental payments and cost share assistance paid by CRP, we estimate that the $500 million paid by CRP would include $420.9 million in rental payments to farmers and $79.15 million in cost share assistance. However, because CRP cost share assistance is a 50:50 cost share, we assume that farmers will spend $79.15 million of their rental payments on planting activities. Thus, the total spent on planting is approximately $158.3 million and rents received by farmers net of planting expenditures is $341.7 million.

Our application of *Status* for this analysis involved the following steps:

- Specify dollar amounts to be modeled in *Status*;
- Specify sectors in Status for modeling investment expenditures;
- Perform *Status* model runs, and
- Allocate national results from *Status* to the state level.

We describe each of these steps in detail below.

SPECIFY DOLLAR AMOUNTS TO MODEL IN *STATUS*

The public and working lands policies considered here specify levels of funding ranging from $250 million in federal grants for anaerobic digesters to $1 billion in federal outlays for both wildland firefighting and hazardous fuels management thinning activities. Exhibit 1 specifies the total funding level modeled for each policy proposal, as well as the timeline over which the expenditures are assumed to take place.

The proposals related to expanding USDA Conservation Reserve Program (CRP) funding for tree planting and grassland restoration on marginal lands require additional calculation of the dollar amounts for modeling in *Status*. This is due to each of these policies including two components (consistent with CRP's existing payment system): rental payments to landowners and a cost sharing component for replanting activities. To determine the share of total funding devoted to each of these components, we rely on CRP data for expenditures on cost sharing and rents for land enrolled in the program in 2019 and 2020. Assuming that cost share payments are largely made during the first two years of program enrollment (i.e., for seeding to establish trees or grassland), data published by the CRP on rental payments and cost share payments suggest that rents make up 68 percent of expenditures on land during its first two years in the CRP and that cost share payments make up the remaining 32 percent.[7] Stated differently, the ratio of cost share outlays to rent outlays during years in which both are paid is 0.4701 (32 ÷ 68 =0.4701). Rents are paid throughout the modeled five years, but cost sharing is restricted to the first two program years, as stated above. Using the ratio of cost shares to rents for the first two years, we set up the following equations for each of the five program years, where *r* is the value for annual outlays for rent:

$$Years\ 1, 2: Annual\ Outlays = r + 0.4701(r)$$

$$Years\ 3, 4, 5: Annual\ Outlays = r$$

In the context of this analysis, we solve for *r* by summing across all five program years and using the total policy funding level of $500 million:

$$\$500\ \text{million} = 5.94(r)$$

[7] Conservation Reserve Program Annual Summary and Enrollment Statistics (2020). Available at: https://www.fsa.usda.gov/programs-and-services/conservation-programs/reports-and-statistics/conservation-reserve-program-statistics/index. Based on this source, 2020 CRP rental payments for acres enrolled in 2019 and 2020 totaled $76.5 million (934,423 acres with an average rental rate of $81.88/acre); cost share payments for these lands were $36.0 million.

Based on this equation, *r* is equal to $84.17 million. Thus, we assume $84.17 million is spent on rents in each of the five program years, and $39.57 million is spent on cost shares in the first two years of the program (i.e., 47.01 percent of $84.17 million). These values represent the makeup of federal outlays through the CRP. However, because CRP cost share assistance is a 50:50 cost share, we assume that farmers use $39.57 million of the rental payments they receive to fund planting activities on their land. Thus, net rental payments are lower during the first two years of enrollment at $44.6 million, as landowners contribute an equal part to cost share activities. Taking this into account, during each of the first two years we model $44.6 million in net rents to farmers and $79.1 in expenditures on planting and restoration activities. During each of years three, four, and five, we model only the full $84.2 million in rents each year. We apply this methodology to both grasslands and forest land, under the assumption that the CRP's proportional distribution between rent and cost share is the same for grassland and forest.[8]

The total funding level and expenditure timeline for each of the public and working lands policies considered in this report is summarized in Exhibit 1.

SPECIFY SECTORS IN *STATUS* FOR MODELING INVESTMENT EXPENDITURES

When modeling the economic impacts associated with public and working lands investments, these expenditures must be allocated to individual industries within *Status*, as the impacts associated with increased demand for one industry's output may differ from the corresponding impacts associated with output produced by another industry. Exhibit 2 summarizes the allocation of expenditures across sectors for each working land policy analyzed. As shown in the exhibit, expenditures may be allocated to any combination of the following:

- **Individual sectors in *Status*:** For several policies, a portion or all of the expenditures are simply allocated to individual industry sectors included in the Status model. Expenditures allocated to these industries are, in effect, treated as an increase in demand for the goods and services produced by these industries. The allocation of expenditures to individual sectors includes allocation of rental payments, which we model as an increase in income for the household sector.
- **Sectoral allocations associated with construction:** One of the public and working lands policies (i.e., the policy related to anaerobic digesters) involve construction activity. For several types of construction, Inforum maintains expenditure profiles that show the allocation of construction spending across individual sectors within *Status*. For example, Inforum's data includes the composition of spending associated with construction activity on farms. For those policies that involve construction that aligns with one of Inforum's existing construction-focused expenditure distributions, we apply the distribution maintained by Inforum.

[8] We acknowledge that the distribution between rent and cost share could vary for grassland versus forests. The data published by the CRP, however, are not sufficiently detailed to develop separate breakouts for grassland and forest land.

EXHIBIT 2. KEY ANALYTIC ASSUMPTIONS FOR ANALYSIS OF EACH POLICY

POLICY TYPE	POLICY	TOTAL FUNDING LEVEL	COMPOSITION OF EXPENDITURES	SPATIAL ALLOCATION
Federal Land Management	Increase funding for USFS wildland firefighters	$1 billion in federal outlays	100% of expenditures allocated to Inforum Commodities - "Forestry, fishing and agricultural support activities"	Direct impacts allocated proportionately to top 15 states by acres burned per year, 2002-2018:[1] Alaska: 24.9% California: 10.9% Idaho: 9.0% Texas: 8.4% Oregon: 7.5% Nevada: 6.7% Montana: 5.9% Arizona: 4.9% New Mexico: 4.7% Washington: 4.1% Oklahoma: 3.6% Utah: 3.0% Colorado: 2.5% Florida: 2.3% Wyoming: 1.7% Allocate indirect & induced effects based on STEMS distribution.
	Federal forest thinning	$1 billion in federal outlays	Thinning expenditures allocated to Inforum Commodities - "Forestry, fishing and agricultural support activities" For commercial timber recovered by thinning, downstream employment impacts are estimated for the wood products industry and paper industry, based on data in Sorenson et al. (2016).[2] These downstream employment impacts (for both the wood products and paper industries) are used as inputs in Inforum's STATUS model to estimate the corresponding indirect and induced effects (netting out indirect effects for the "Forestry, fishing and agricultural support activities" industry to avoid double counting).	Direct impacts allocated proportionately to top 15 states by acres burned per year, 2002-2018:[1] Alaska: 24.9% California: 10.9% Idaho: 9.0% Texas: 8.4% Oregon: 7.5% Nevada: 6.7% Montana: 5.9% Arizona: 4.9% New Mexico: 4.7% Washington: 4.1% Oklahoma: 3.6% Utah: 3.0% Colorado: 2.5% Florida: 2.3% Wyoming: 1.7% Allocate indirect & induced effects based on STEMS distribution.

POLICY TYPE	POLICY	TOTAL FUNDING LEVEL	COMPOSITION OF EXPENDITURES	SPATIAL ALLOCATION
Federal Land Management (continued)	Federal forest replanting	$500 million in federal outlays	Expenditures allocated as follows: 40% allocated to LIFT Commodities - Crop production 60% allocated to LIFT Commodities - Forestry, fishing and agriculture support activities	Direct impacts allocated proportionately to top 15 states by acres burned per year, 2002-2018:[1] Alaska: 24.9% California: 10.9% Idaho: 9.0% Texas: 8.4% Oregon: 7.5% Nevada: 6.7% Montana: 5.9% Arizona: 4.9% New Mexico: 4.7% Washington: 4.1% Oklahoma: 3.6% Utah: 3.0% Colorado: 2.5% Florida: 2.3% Wyoming: 1.7% Allocate indirect & induced effects based on STEMS distribution.
Incentives to Private Landowners	Forestry – tree planting on marginal lands not used for production	$500 million in federal outlays, ~$341.7 million modeled as net rental payments to landowners and ~$158.3 million as cost share assistance to landowners for planting activities.	Expenditures for rent and cost share allocated separately as follows: **Cost Share** 40% allocated to LIFT Commodities - Crop production 60% allocated to LIFT Commodities - Forestry, fishing and agriculture support activities **Rent** Modeled as increase in household income	Allocate direct effects to top 15 states by land area with potential for marginal lands restoration, distributed by area:[3] Missouri: 9.0% Idaho: 8.2% Arkansas: 8.0% California: 7.3% Ohio: 7.3% Tennessee: 6.8% Mississippi: 6.7% Florida: 6.5% Montana: 6.5% Iowa: 6.1% Texas: 6.0% Indiana: 5.9% Kentucky: 5.6% Pennsylvania: 5.2% Michigan: 5.1% Allocate indirect & induced effects based on STEMS distribution.
	Agriculture – cover crop development	$500 million in federal outlays.	100% of expenditures allocated to LIFT Commodities - Crop production	Allocate direct effects to top 15 states by cover crop acreage planted in 2017, distributed by area:[4] Texas: 9.8% Iowa: 9.4% Indiana: 9.0% Missouri: 8.1% Nebraska: 7.2% Ohio: 6.9% Illinois: 6.8% Michigan: 6.5% Wisconsin: 5.9% Pennsylvania: 5.7% Minnesota: 5.6% Kansas: 5.4% Georgia: 5.1% North Carolina: 4.7% Kentucky: 4.0% Allocate indirect & induced effects based on STEMS distribution.

POLICY TYPE	POLICY	TOTAL FUNDING LEVEL	COMPOSITION OF EXPENDITURES	SPATIAL ALLOCATION
Incentives to Private Landowners (continued)	Grassland restoration	$500 million in federal outlays, ~$341.7 million modeled as net rental payments to landowners and ~$158.3 million as cost share assistance to landowners for planting activities.	Expenditures for rent and cost share allocated separately as follows: **Cost Share** 40% allocated to LIFT Commodities - Crop production 60% allocated to LIFT Commodities - Forestry, fishing and agriculture support activities **Rent** Modeled as increase in income for households.	Allocate direct effects to top 15 states by CRP program signups, distributed by acres accepted:[5] South Dakota: 30.8% Nebraska: 24.3% Montana: 14.2% Colorado: 7.3% Wyoming: 5.0% Kansas: 4.5% North Dakota: 3.0% Utah: 1.9% Oklahoma; 1.7% Idaho: 1.6% Oregon: 1.6% New Mexico: 1.4% Texas: 1.1% Michigan: 1.0% Washington: 0.8% Allocate indirect and induced effects based on STEMS distribution.
	Anaerobic digesters	$250 million in grants.	Expenditures allocated according to Inforum's existing sectoring scheme for private farm construction.	Allocate direct effects to proportionately to top ten states based on total energy potential from two major categories, swine and dairy:[6] California: 27.0% Iowa: 20.1% North Carolina: 10.1% Idaho: 9.6% Wisconsin: 7.5% Minnesota: 6.3% Texas: 5.9% New Mexico: 5.2% Illinois: 4.5% Washington: 4.0% Allocate indirect and induced effects based on STEMS distribution.

Notes:

1. Distribution derived from CoreLogic, "2019 Wildfire Risk Report", 2019, available at https://www.corelogic.com/downloadable-docs/wildfire-report_0919-01-screen.pdf.
2. Sorenson, C. B., Keegan III, C. E., Morgan, T. A., McIver, C. P., & Niccolucci, M. J. (2016). Employment and wage impacts of timber harvesting and processing in the United States. *Journal of Forestry*, *114*(4), 474-482.
3. Distribution reflects acres classified as pasture and croplands with challenging soil conditions and limited production, shrublands, urban open space, floodplains with 5-year flood return intervals, and areas within 30 meters of a stream. Data from Susan C. Cook-Patton, Trisha Gopalakrishna, Adam Daigneault, Jenny L. McGuire, Samantha M. Yeo, and Joseph E. Fargione, "Lower cost and more feasible options to restore forest cover in the contiguous United States for climate mitigation," *One Earth*; Vol. 3, Issue 6, pp. 739-752; December 18, 2020..
4. Distribution for cover cropping based on Soil Health Institute, "Progress Report: Adoption of Soil Health Systems Based on Data from the 2017 U.S. Census of Agriculture", available at https://soilhealthinstitute.org/wp-content/uploads/2019/07/Soil-Health-Census-Report.pdf
5. Distribution reflects states with the highest number of acres accepted into the CRP Grasslands Program, based on 2020 data from the Conservation Reserve Program. Available at: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index
6. Distribution derived from U.S. EPA, "Market Opportunities for Biogas Recovery Systems at U.S. Livestock Facilities", June 2018, available at https://www.epa.gov/sites/production/files/2018-06/documents/epa430r18006agstarmarketreport2018.pdf.

PERFORM *STATUS* RUNS

Based on the investment amounts above and the allocation of this investment spending to individual sectors in *Status*, we performed *Status* model runs that estimated the direct, indirect, and induced economic impacts associated with the public and working lands policy proposals.

ALLOCATE IMPACTS TO THE STATE LEVEL

The *Status* model generates results at the national level. To allocate results to the state level, we follow two separate approaches: one for direct impacts and another for indirect and induced impacts. We allocate estimates of *direct* impacts to individual states based on the expected spatial distribution of the public and working lands policy proposals, as summarized in Exhibit 2.[9] We allocate indirect and induced impacts using Inforum's State Employment Modeling System (STEMS). Using data derived from the Bureau of Labor Statistics' Employment and Earnings data, STEMS estimates employment for individual industries in each state. The industries are divided into two groups: base and secondary. Estimates for the base group industries are dependent on national levels of employment and trends in state shares of national employment. Estimates for the secondary group industries are also dependent on national levels and state trends, as well as on estimates for the base industries in the same state. The base industries are those engaged in manufacturing, agriculture, and mining, along with federal government "industry". Secondary industries are those engaged in providing services, and the construction industry. Employment estimates in STEMS are not based on constant shares, but respond to trends in individual industries.

DOWNSTREAM IMPACTS ASSOCIATED WITH FOREST THINNING

Unlike the other policies examined in this analysis, the federal forest thinning policy would result in economic impacts downstream from the primary activity modeled. Specifically, the processing and use of commercially viable timber harvested through forest thinning would result in economic impacts beyond those associated with thinning operations. While we apply the above approach to estimate the economic impacts of thinning operations, we apply a separate approach for the assessment of downstream economic impacts, which involves the following steps:

- ***Estimate commercially viable timber recovered through thinning:*** To estimate the amount of commercially recoverable timber resulting from this policy, we rely on data from the USDA for hazardous fuels management thinning projects occurring since 2004.[10] Across the projects completed during this timeframe for

[9] The exact spatial allocation of the spending under these policy proposals is uncertain. We identify the states most likely to be affected by the proposed policies as a means for estimating employment impacts.

[10] USDA (2021) Timber Harvests ESRI Geodatabase. Available at: https://data.fs.usda.gov/geodata/edw/datasets.php?xmlKeyword=Timber+Harvests

which data are available on both project costs and the recovery of commercially viable timber, we calculate an average of 0.436 cubic feet of timber per dollar spent (in year 2019$) on thinning.[11] Because the $200 million in annual spending associated with the policy is in current dollars (as opposed to constant dollars), the amount of timbered recovered per dollar spent declines slightly over time. In 2025 (the end of the analytic time horizon for this policy), the amount recovered is approximately 0.383 cubic feet per dollar spent on thinning. Using the values specific to each year, we calculate the volume of timber harvested annually, by state, as a result of $200 million in annual spending.[12]

- ***Allocate harvested timber by state to different uses/industries:*** To allocate the state-specific estimates of timber harvested to individual industries, we rely on regional data published by the USDA on the distribution of harvested timber across uses.[13] Note that wood assumed to be used for fuel is excluded from this allocation, as this analysis assumes no downstream economic impacts for wood used as fuel wood. Based on USDA cut and sold data for the states included in the thinning analysis, approximately 9.1 percent of wood harvested from federal lands in these states is used as fuel wood.[14]
- ***Map USDA Uses to Uses in Sorenson et al. (2016):*** Because we apply coefficients from Sorenson et al. (2016) to estimate direct employment per million cubic feet of timber used in different applications (see the next step below), we map the uses from USDA to the industries specified in Sorenson et al. (2016).[15]
- ***Apply Employment Coefficients from Sorenson et al. (2016) to estimate downstream employment for each use category:*** Based on the volume of timber allocated to individual uses/industries specified in Sorenson et al. (2016) and the

[11] In developing this estimate, we restrict our search to hazardous fuels management thinning projects occurring within the 15 states where this spending is expected to take place, which we identify as the top 15 states by National Forest acres burned due to wildfire from 2002-2018. Of these, the states with useable thinning project data are Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. In calculating the average cubic feet of timber per dollar spent on thinning, we weight the average value for each of these states by its expected share of total funding for hazardous fuels management thinning, as outlined in Exhibit 2.

[12] To the extent that past hazardous fuels thinning efforts have focused on areas with more financially viable timber for recovery than areas with the highest wildfire risk, the spatial distribution applied in this analysis may not accurately represent where the need for thinning is greatest. For the purposes of this analysis, however, the historical distribution represents the best available information on where thinning is likely to occur.

[13] USDA. (2017) Forest Resources of the United States, Table 39. Available at: https://www.fs.fed.us/research/publications/gtr/gtr_wo97.pdf

[14] See US Forest Service (2021) "Forest Products Cut and Sold from the National Forests and Grasslands – Fiscal Year 2020." https://www.fs.fed.us/forestmanagement/products/cut-sold/index.shtml.

[15] Sorenson, C. B., Keegan III, C. E., Morgan, T. A., McIver, C. P., & Niccolucci, M. J. (2016) Employment and wage impacts of timber harvesting and processing in the United States. *Journal of Forestry*, *114*(4), 474-482.

direct response coefficients presented in the Sorenson et al. study, we estimate downstream employment impacts as follows:

$$E_i = \sum_s \left(V_{s,i} \times DRC_{s,i}\right)$$

Where:

E_i is the total expected employment effect, measured in persons employed, due to downstream processing or use of timber resulting from hazardous fuels management thinning in industry sector *i.*

$V_{s,i}$ is the volume of the harvest in cubic feet, as described above, distributed to each state *s* by the share of total policy funding the state is expected to receive and allocated to each industry *i* based on the USDA data described above,

$DRC_{s,i}$ is the Direct Response Coefficient from Sorenson et al. (2016) for each state *s* and industry sector *i*, measured in expected employment effect per cubic feet of timber processed.[16]

- ***Map Estimates to Sectors in Status Model:*** The previous step provides estimates of direct employment impacts for wood-using industries as defined in Sorenson et al. (2016). These estimates serve as inputs into the *Status* input-output model (see below).[17] Prior to applying these inputs in *Status*, we crosswalk them with the more aggregated industry sectors defined in the model. Each of the industries defined in the Sorenson et al. study corresponds to either the wood products industry or paper industry in *Status*.
- ***Perform Status Runs and Process Results:*** Using the direct employment impacts for the wood products and paper industries as inputs, we ran *Status* to estimate the full suite of direct, indirect, and induced impacts associated with the downstream use of harvested timber. Adding these results to the estimated impacts of thinning operations, however, would result in double counting of some impacts. Specifically, the indirect impacts to the forestry industry associated with the production of wood products and paper products are captured as the direct impacts associated with thinning operations (estimated according to the approach in the previous section). To avoid double counting, we exclude indirect effects associated with the forestry industry from the *Status* results. We also perform a similar adjustment for induced effects (i.e., for the portion of induced effects that result from indirect worker compensation in the forestry industry).

[16] Sorenson, Colin B., et al. "Employment and wage impacts of timber harvesting and processing in the United States." *Journal of Forestry* 114.4 (2016): 474-482.

[17] *Status* accepts inputs in terms of both additional sectoral spending and employment effects. We use employment effects here, as this is the unit of the Direct Response Coefficients in the Sorenson et al (2016) paper we rely on for this analysis.

RESULTS

Following the approach outlined above, we estimated the employment and GDP impacts of each public and working lands stimulus policy option. Exhibit 3 shows the average annual impacts to employment and GDP by policy. The average annual employment impacts by policy range from 500 to over 8,000 jobs per policy. Average annual GDP impacts range from $62 million to nearly $900 million per policy. Exhibit 4 shows the annual GDP and employment impacts of all the stimulus policies combined over the 2021 to 2025 period. As the exhibit shows, the policies are projected to result in a large stimulative effect in the near-term, contributing between $1.4 billion and $2.2 billion to annual GDP each year through 2025 and supporting between 11,000 and 22,000 jobs each year during this period. Exhibit 4 also shows a decline in both employment and GDP impacts after 2022. This reflects the short (two-year) timeframe of the proposed wildland firefighting policy.

EXHIBIT 3. AVERAGE ANNUAL EMPLOYMENT AND GDP IMPACTS BY POLICY[1]

POLICY TYPE	STIMULUS POLICY	TOTAL FEDERAL FUNDING LEVEL[2]	AVERAGE ANNUAL JOBS SUPPORTED	AVERAGE ANNUAL GDP SUPPORTED (2019$)
Federal Lands Management	**Hiring, training, and deploying more wildland firefighters**	**$1 billion over 2 years**	8,050	$677 million
	Federal forest thinning (Total)	**$1 billion over 5 years**	7,840	$895 million
	Federal forest thinning (Part 1 - Thinning Operations)		3,100	$261 million
	Federal forest thinning (Part 2 - Timber Processing and Use)		5,500	$693 million
	Federal forest replanting	**$500 million over 5 years**	1,180	$110 million
Incentives to Private Landowners	**Planting trees on marginal lands**	**$500 million over 5 years**	980	$133 million
	Cover cropping	**$500 million over 5 years**	640	$79 million
	Grassland restoration on marginal lands	**$500 million over 5 years**	980	$133 million
	Installation of anaerobic digesters	**$250 million over 5 years**	500	$62 million

Notes:

1. Average annual employment and GDP impacts for each policy are based on impacts for the number of years funded. For example, the impacts associated with federal forest replanting are based on annual impacts estimated over a five-year period. Jobs listed here include direct, indirect, and induced.
2. The federal funding level for each policy represents resources committed by the federal government. Some policies (e.g., those with a cost-sharing requirement) would result in a total expenditure in excess of the federally funded amount. In addition, for those policies that include a rental component paid to landowners (i.e., the policies promoting tree planting and grassland restoration on private lands), the employment and GDP impacts presented here are based on the funding used for non-rental purposes (e.g., to pay for tree planting).

EXHIBIT 4. TOTAL EMPLOYMENT AND GDP EFFECTS ACROSS ALL POLICIES, 2019$

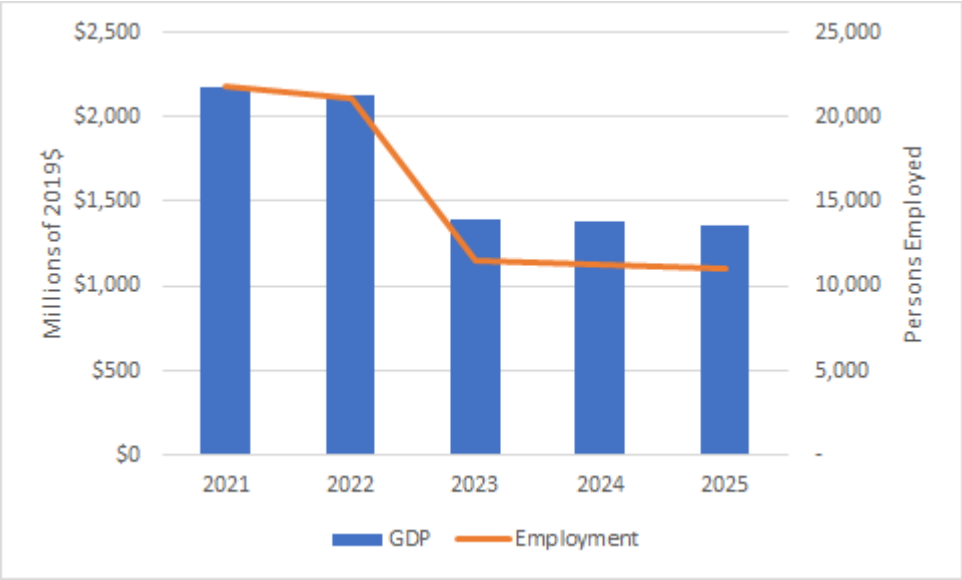


Exhibit 5 presents the annual employment impacts of the public and working lands policies by year and individual policy over the 2021 to 2025 period, while Exhibits 6 and 7 present impacts by year and policy for GDP and labor income, respectively. For each metric, impacts are highest in 2021 and 2022, as they are buoyed by the hiring of additional wildland firefighters in those two years. After 2022, annual employment, GDP, and income impacts remain fairly constant. Aside from spending under the firefighter policy ending after 2022, the slight decline in impacts over time reflects the fact that the annual investment amounts are in nominal dollars. Thus, in real (inflation-adjusted terms), the annual investment amount declines over time.

Exhibits 8 and 9 break out the jobs impacts by direct, indirect, and induced employment. As shown in the exhibits, direct employment impacts (jobs associated with industries directly involved in the implementation of each policy) account for the largest share of the estimated total.

Exhibits 10 and 11 show employment impacts per 1,000 residents by state. Exhibit 10 shows the total employment impacts for policies focused on the management of federal land, while Exhibit 11 highlights the total employment impacts for the proposed polices related to private lands. In each category, the per capita labor impacts are concentrated in the western U.S. Alaska sees the biggest per capita labor impact for the federal land policies, while South Dakota is projected to experience the most significant impact from the policies focused on private land. These findings reflect the assumed spatial distribution of spending in Exhibit 2, which shows that an estimated 24.9 percent of spending on federal lands policies are allocated to Alaska and that 30 percent of grassland restoration expenditures for private lands are allocated to South Dakota.

EXHIBIT 5. TOTAL EMPLOYMENT EFFECTS BY POLICY, 2021-2025 (PERSONS EMPLOYED)

POLICY TYPE	STIMULUS POLICY	2021	2022	2023	2024	2025
Federal Lands Management	Hiring, training, and deploying more wildland firefighters	8,200	7,900	-	-	-
	Federal forest thinning (Total)	8,300	8,000	7,800	7,700	7,400
	Federal forest thinning (Part 1 - Thinning Operations)	3,300	3,200	3,100	3,000	2,900
	Federal forest thinning (Part 2 - Timber Processing)	5,700	5,600	5,500	5,400	5,300
	Federal forest replanting	1,300	1,200	1,200	1,100	1,100
Incentives to Private Landowners	Planting trees on marginal lands	1,400	1,400	700	700	700
	Cover cropping	700	700	600	600	600
	Grassland restoration on marginal lands	1,400	1,400	700	700	700
	Installation of anaerobic digesters	500	500	500	500	500
	Total across all policies:	**21,800**	**21,100**	**11,500**	**11,300**	**11,000**

EXHIBIT 6. GDP IMPACTS OF BY POLICY, 2021-2025 (MILLIONS OF YEAR 2019$)

POLICY TYPE	STIMULUS POLICY	2021	2022	2023	2024	2025
Federal Lands Management	Hiring, training, and deploying more wildland firefighters	$685	$668	-	-	-
	Federal forest thinning (Total)	$906	$899	$897	$894	$882
	Federal forest thinning (Part 1 - Thinning Operations)	$274	$267	$261	$256	$249
	Federal forest thinning (Part 2 - Timber Processing)	$689	$690	$695	$699	$692
	Federal forest replanting	$115	$113	$110	$108	$105
Incentives to Private Landowners	Planting trees on marginal lands	$158	$154	$120	$118	$115
	Cover cropping	$83	$81	$80	$78	$76
	Grassland restoration on marginal lands	$158	$154	$120	$118	$115
	Installation of anaerobic digesters	$65	$63	$62	$61	$60
	Total across all policies:	**$2,170**	**$2,132**	**$1,390**	**$1,377**	**$1,353**

EXHIBIT 7. LABOR INCOME IMPACTS BY POLICY, 2021-2025 (MILLIONS OF YEAR 2019$)

POLICY TYPE	STIMULUS POLICY	2021	2022	2023	2024	2025
Federal Lands Management	Hiring, training, and deploying more wildland firefighters	$378	$370	-	-	-
	Federal forest thinning (Total)	$477	$468	$464	$462	$456
	Federal forest thinning (Part 1 - Thinning Operations)	$151	$148	$145	$143	$140
	Federal forest thinning (Part 2 - Timber Processing)	$359	$354	$352	$353	$350
	Federal forest replanting	$59	$57	$56	$55	$54
Incentives to Private Landowners	Planting trees on marginal lands	$75	$73	$50	$49	$48
	Cover cropping	$33	$32	$31	$31	$30
	Grassland restoration on marginal lands	$75	$73	$50	$49	$48
	Installation of anaerobic digesters	$35	$34	$34	$33	$32
	Total across all policies:	**$1,133**	**$1,107**	**$686**	**$679**	**$669**

EXHIBIT 8. EMPLOYMENT IMPACTS FOR POLICIES RELATED TO MANAGEMENT OF FEDERAL LAND, 2021 (PERSONS EMPLOYED)

POLICY	DIRECT IMPACTS	INDIRECT IMPACTS	INDUCED IMPACTS	TOTAL IMPACTS
Hiring, training, and deploying more wildland firefighters	5,000	1,100	2,100	8,200
Federal forest thinning	3,600	1,800	2,900	8,300
Federal forest thinning (Part 1 – Tree Operations)	2,000	400	800	3,300
Federal forest thinning (Part 2 – Timber Processing)	1,600	1,900	2,200	5,700
Federal forest replanting	700	200	400	1,300

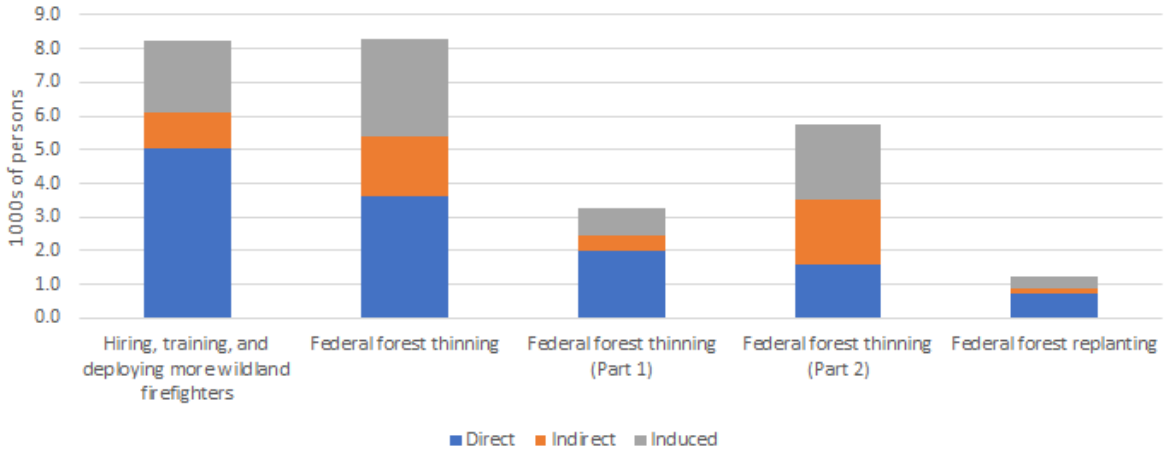


EXHIBIT 9. EMPLOYMENT IMPACTS FOR POLICIES RELATED TO MANAGEMENT OF PRIVATE LAND, 2021 (PERSONS EMPLOYED)

POLICY	DIRECT IMPACTS	INDIRECT IMPACTS	INDUCED IMPACTS	TOTAL IMPACTS
Planting trees on marginal lands	600	300	500	1,400
Cover Cropping	300	200	300	700
Grassland Restoration	600	300	500	1,400
Anaerobic Digesters	300	100	200	500

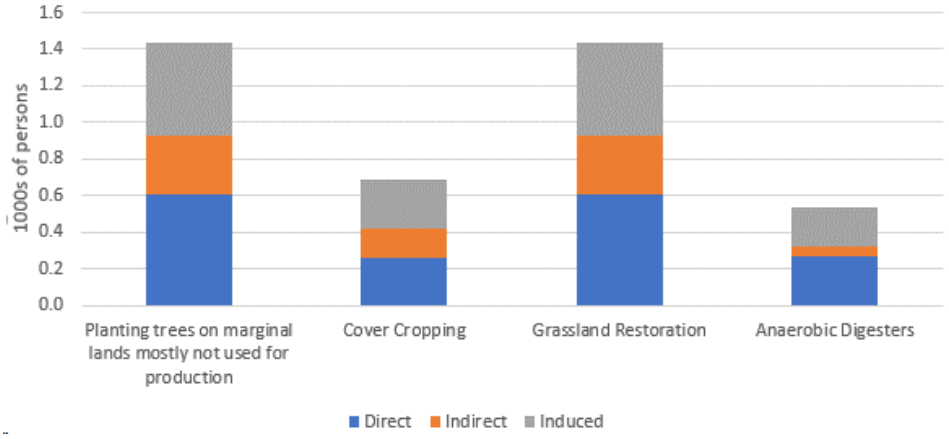


EXHIBIT 10. EMPLOYMENT EFFECTS PER 1,000 RESIDENTS BY STATE, 2021 – POLICIES RELATED TO MANAGEMENT OF FEDERAL LAND

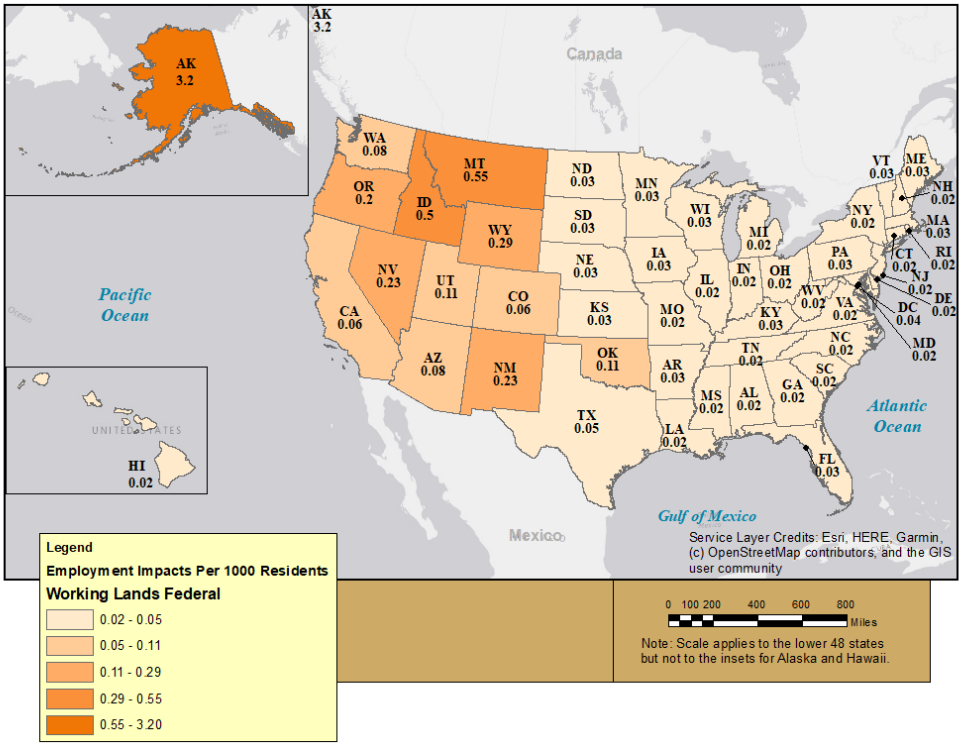
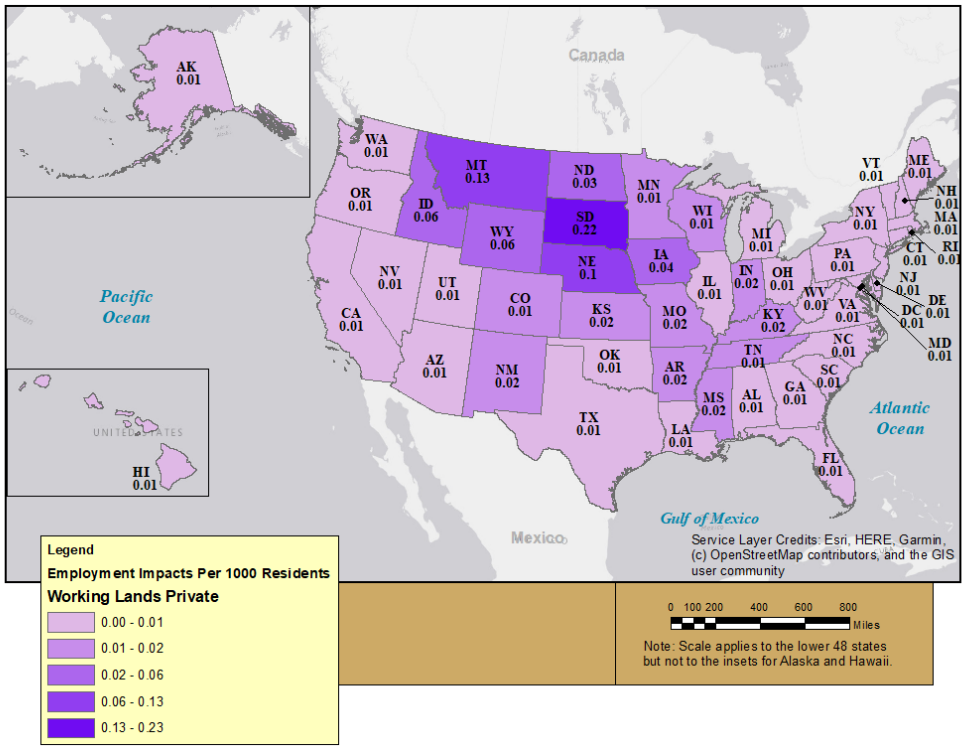


EXHIBIT 11. EMPLOYMENT EFFECTS PER 1,000 RESIDENTS BY STATE, 2021 – POLICIES RELATED TO MANAGEMENT OF PRIVATE LAND



APPENDIX

EMPLOYMENT IMPACTS BY POLICY TYPE, STATE, AND YEAR

EXHIBIT A-1. TOTAL EMPLOYMENT IMPACTS ACROSS ALL PUBLIC AND WORKING LANDS POLICIES, BY STATE AND YEAR (PERSONS EMPLOYED)

State	2021	2022	2023	2024	2025
Alabama	100	100	100	90	90
Alaska	2,300	2,300	1,000	1,000	1,000
Arizona	700	600	300	300	300
Arkansas	200	100	70	70	70
California	2,800	2,700	1,500	1,500	1,400
Colorado	500	400	200	200	200
Connecticut	100	100	70	70	60
Delaware	30	30	20	20	20
Dist. of Col.	40	40	30	30	30
Florida	900	900	500	500	500
Georgia	300	300	200	200	200
Hawaii	40	40	30	30	30
Idaho	1,000	1,000	400	400	400
Illinois	400	400	300	300	300
Indiana	300	300	200	200	200
Iowa	200	200	200	100	100
Kansas	100	100	80	80	70
Kentucky	200	200	100	100	100
Louisiana	100	100	90	90	80
Maine	50	50	30	30	30
Maryland	200	200	100	100	100
Massachusetts	200	200	200	200	100
Michigan	300	300	200	200	200
Minnesota	200	200	200	200	200
Mississippi	100	100	60	60	60
Missouri	300	300	200	100	100
Montana	700	700	300	300	300
Nebraska	200	200	90	80	80
Nevada	700	700	300	300	300
New Hampshire	40	40	30	30	30
New Jersey	300	300	200	200	200
New Mexico	500	500	200	200	200
New York	600	600	400	400	400
North Carolina	400	300	200	200	200
North Dakota	50	50	20	20	20
Ohio	400	400	300	200	200
Oklahoma	500	400	200	200	200
Oregon	900	900	400	400	400
Pennsylvania	500	400	300	300	300

State	2021	2022	2023	2024	2025
Rhode Island	30	30	20	20	20
South Carolina	200	100	100	100	90
South Dakota	200	200	50	50	40
Tennessee	200	200	100	100	100
Texas	1,700	1,700	900	900	900
Utah	400	400	200	200	200
Vermont	20	20	10	10	10
Virginia	300	200	200	200	200
Washington	700	700	400	400	300
West Virginia	50	40	30	30	30
Wisconsin	200	200	200	200	200
Wyoming	200	200	80	80	80
Total[1]	21,900	21,000	11,600	11,300	11,000

Notes:
1. Totals may not exactly match those in the main body of this document due to rounding.

EXHIBIT A-2. EMPLOYMENT IMPACTS FOR PUBLIC AND WORKING LANDS POLICIES FOCUSED ON FEDERAL LANDS, BY STATE AND YEAR (PERSONS EMPLOYED)

State	2021	2022	2023	2024	2025
Alabama	100	100	70	70	70
Alaska	2,300	2,300	1,000	1,000	1,000
Arizona	600	600	300	300	300
Arkansas	80	80	50	50	50
California	2,400	2,300	1,200	1,200	1,100
Colorado	400	400	200	200	200
Connecticut	80	80	50	50	40
Delaware	20	20	10	10	10
Dist. of Col.	30	30	20	20	20
Florida	700	700	400	400	400
Georgia	300	200	200	100	100
Hawaii	30	30	20	20	20
Idaho	900	900	400	400	400
Illinois	300	300	200	200	200
Indiana	200	200	100	90	90
Iowa	90	90	60	50	50
Kansas	80	70	40	40	40
Kentucky	100	100	70	60	60
Louisiana	100	100	60	60	60
Maine	40	40	20	20	20
Maryland	100	100	70	70	70
Massachusetts	200	200	100	100	100
Michigan	200	200	100	100	100
Minnesota	200	100	90	90	90
Mississippi	70	70	40	40	40
Missouri	100	100	90	80	80
Montana	600	600	300	300	200
Nebraska	60	60	40	30	30
Nevada	700	700	300	300	300
New Hampshire	30	30	20	20	20
New Jersey	200	200	100	100	100
New Mexico	500	500	200	200	200
New York	500	400	300	300	300
North Carolina	200	200	100	100	100
North Dakota	30	20	20	10	10
Ohio	300	300	200	200	200
Oklahoma	400	400	200	200	200
Oregon	900	800	400	400	400

State	2021	2022	2023	2024	2025
Pennsylvania	300	300	200	200	200
Rhode Island	20	20	10	10	10
South Carolina	100	100	70	70	70
South Dakota	30	30	20	20	10
Tennessee	200	200	100	90	90
Texas	1,400	1,400	700	700	700
Utah	400	300	200	200	200
Vermont	20	20	10	10	10
Virginia	200	200	100	100	100
Washington	600	600	300	300	300
West Virginia	40	30	20	20	20
Wisconsin	200	200	100	100	90
Wyoming	200	200	80	70	70
Total	17,800	17,100	9,000	8,800	8,500

EXHIBIT A-3. EMPLOYMENT IMPACTS FOR PUBLIC AND WORKING LANDS POLICIES FOCUSED ON PRIVATE LANDS, BY STATE AND YEAR (PERSONS EMPLOYED)

State	2021	2022	2023	2024	2025
Alabama	30	30	30	20	20
Alaska	-	-	-	-	-
Arizona	50	40	40	40	40
Arkansas	70	70	20	20	20
California	500	400	300	300	300
Colorado	90	80	40	40	40
Connecticut	20	20	20	20	20
Delaware	10	10	10	10	10
Dist. of Col.	10	10	10	10	10
Florida	200	200	100	100	100
Georgia	80	80	70	70	70
Hawaii	10	10	10	10	10
Idaho	100	100	40	40	40
Illinois	100	100	100	100	100
Indiana	100	100	70	60	60
Iowa	100	100	100	90	90
Kansas	60	60	30	30	30
Kentucky	70	70	40	40	40
Louisiana	30	30	30	20	20
Maine	10	10	10	10	10
Maryland	40	40	30	30	30
Massachusetts	60	50	50	50	40
Michigan	100	100	80	70	70
Minnesota	80	70	70	60	60
Mississippi	60	60	20	20	20
Missouri	100	100	60	60	60
Montana	100	100	20	20	20
Nebraska	200	200	50	50	50
Nevada	20	20	20	20	20
New Hampshire	10	10	10	10	10
New Jersey	60	60	50	50	50
New Mexico	30	30	20	20	20
New York	100	100	100	100	100
North Carolina	100	100	90	90	90
North Dakota	30	20	10	10	10
Ohio	100	100	90	90	90
Oklahoma	30	30	20	20	20
Oregon	50	40	30	30	30
Pennsylvania	100	100	100	90	90

State	2021	2022	2023	2024	2025
Rhode Island	10	10	10	10	10
South Carolina	30	30	30	30	30
South Dakota	200	200	30	30	30
Tennessee	90	80	50	40	40
Texas	300	300	200	200	200
Utah	30	30	20	20	20
Vermont	-	-	-	-	-
Virginia	60	50	50	50	50
Washington	80	70	60	50	50
West Virginia	10	10	10	10	10
Wisconsin	80	80	70	70	60
Wyoming	30	30	10	10	10
Total	4,100	3,900	2,600	2,500	2,400