Appendix R

Economic Impact Analysis Methodology

APPENDIX R
ECONOMIC IMPACT ANALYSIS METHODOLOGY

INTRODUCTION

This appendix describes the methods and data that underlie the economic impact modeling analysis. Input-output models such as the Impact Analysis for Planning (IMPLAN) model, an economic impact analysis model, provide a quantitative representation of the production relationships between individual economic sectors. Thus, the economic modeling analysis uses information about physical production quantities and the prices and costs for goods and services. The inputs required to run the IMPLAN model are described in the following narrative and tables. The resulting estimates from the IMPLAN model, by alternative, are in Chapter 4, Environmental Consequences, Section 4.19, Social and Economic Impacts (Including Environmental Justice). The first portion of the following information describes general aspects of the IMPLAN model and how it was used to estimate economic impacts. The following section provides additional detailed data used in the analysis for livestock grazing and wind energy development.

THE IMPLAN MODEL

IMPLAN is a regional economic model that provides a mathematical accounting of the flow of money, goods, and services through a region's economy. The model provides estimates of how a specific economic activity translates into jobs and income for the region. It includes the ripple effect (also called the multiplier effect) of changes in economic sectors that may not be directly impacted by management actions, but are linked to industries that are directly impacted. In IMPLAN, these ripple effects are termed indirect impacts (for changes in industries that sell inputs to the industries that are directly impacted) and induced impacts (for changes in household spending as household income increases or decreases due to the changes in production).

This analysis used IMPLAN 2011; prior to running the model, cost and price data were converted to a consistent dollar year (2011) using sector-specific

adjustment factors from the IMPLAN model. However, the values in this appendix are expressed in year 2010 dollars for comparison with baseline data.

The current IMPLAN model has 440 economic sectors, of which 198 are represented in the Socioeconomic Study Area counties. This analysis involved direct changes in economic activity for 32 IMPLAN economic sectors, as well as changes in all other related sectors due to the ripple effect. The IMPLAN production coefficients were modified to reflect the interaction of producing sectors in the primary and secondary Socioeconomic Study Areas. As a result, the calibrated model does a better job of generating multipliers and the subsequent impacts that reflect the interaction between and among the sectors in the Socioeconomic Study Area compared to a model using unadjusted national coefficients. Key variables used in the IMPLAN model were filled in using data specific to the Socioeconomic Study Area, including employment estimates, labor earnings, and total industry output. In addition, for two of the three types of economic activities analyzed – wind energy development and geothermal energy development – input was used from the National Renewable Energy Laboratory's Jobs and Economic Development Impact (JEDI) models (NREL, 2012). These models collected background data for calibrating renewable energy impact models and, therefore, were useful as inputs.

The trade data available in the current version of IMPLAN (Version 3.0) make it possible to do multi-region analysis to track how an impact on any of the IMPLAN sectors in the Study Area affects production in any of the sectors in any other region of the US. For this analysis, this feature allowed the estimation of how an impact in the primary Study Area disperses into the secondary Study Area, and how these effects in the secondary Study Area create additional local effects in the primary Study Area. As a result, it was possible to estimate not only the jobs and income generation in the primary Study Area, but to also estimate how the economic activity in the primary Study Area affected jobs and income generation in the secondary Study Area.

LIVESTOCK GRAZING

Economic impacts from changes to livestock grazing are a function of the amount of forage available and the economic value of forage.

Forage availability was measured in Animal Unit Months (AUMs), with one AUM defined as the amount of forage needed to feed one cow, one horse, or five sheep for one month. Data on forage availability were obtained from BLM's Rangeland Administration System (BLM 2012). Two types of AUM measures were used: active AUMs and billed AUMs. Active AUMs measure the amount of forage from land available for grazing. Billed AUMs measure the amount of forage for which BLM bills annually (i.e., the amount of forage that ranchers actually use, which is typically less than the amount of forage available). Data for 2011 were used for active AUMs. Billed AUMs may be less than active AUMs for various reasons. BLM may require non-use of a portion of the active AUMs

granted for conservation and protection of habitat or for improvement of rangeland conditions. On the other hand, the permittee may choose to reduce the amount of AUMs after land treatments or fire rehabilitation projects or for business reasons (BLM 2014a; 2014b). Because billed AUMs fluctuate considerably from one year to another, data for 2000 to 2011 were used to develop a 12-year average for billed AUMs. Data capture AUMs for entire allotments when those allotments intersect with GRSG habitat.

Forage availability was estimated for all alternatives (BLM 2015). Alternatives A, B, and E used the current data for active AUMs (obtained as explained above) in PHMA and GHMA. The analysis estimated 771,773 total active AUMs in GRSG habitat in the Socioeconomic Study Area (BLM 2015). As under current management, some acres (152,844) in GRSG would be closed for grazing under Alternatives A, B, and E. Alternative C removed 100 percent of active AUMs in GRSG habitat (PPMA and PGMA). Alternative D discounted the current data to remove all Research Natural Areas (RNAs) with at least 20 percent of PPMA acres and 50 percent of PGMA acres. Closures to these areas would be voluntary or by termination. Alternative F assumed that 25 percent of the acreage in GRSG habitat would be rested each year and not available for grazing. In addition, Alternative F assumed a target utilization of only 25 percent of the non-rested acreage in GRSG habitat. This target utilization would be attempted by setting active AUMs at 50 percent of the non-rested acreage in GRSG habitat. This would result in the targeted 25 percent utilization of the non-rested area, if livestock operators follow NRCS stocking rate guides (that typically result in 50 percent use of the authorized area). Therefore, under Alternative F, active AUMs were set at 0.75 x 0.5 = 37.5 percent of the active AUMs under current management. The analysis estimated that of the 771,773 total active AUMs in GRSG habitat (PHMA and GHMA) in the Socioeconomic Study Area, 77,177 would be in the Andrews Field Office (FO) area, 30,871 in the Baker FO area, 38,589 in the Central Oregon FO area, 7,718 in the Deschutes FO area, 316,426 in the Jordan FO and Malheur FO area, 123,484 in the Lakeview FO area, and 177,508 in the Three Rivers FO area. This information was used to calculate the total active AUMs that would be available for grazing under each alternative in GRSG habitat. The results of these calculations are presented below in **Table R-1**.

Table R-2 shows two scenarios for the number of billed AUMs under each alternative. For the high impact scenario, the analysis assumed that livestock operators would choose to maintain a constant ratio of active to billed AUMs so any reduction to active AUMs would result in a proportional reduction to billed AUMs. The analysis applied the current ratio of active to billed AUMs to the calculated number of reduced active AUMs under each alternative to calculate the corresponding number of reduced billed AUMs under each alternative. In addition, the high impact scenario considered the possibility that the loss of AUMs on public lands could lead to the loss of additional AUMs due

Table R-1
Estimated Active Annual Animal Unit Months for Allotments in GRSG Habitat by Alternative for the Study Area

Field Office	Initial	Alternatives A, B, and E	Alternative C	Alternative D	Alternative F	Proposed Plan
Andrews	77,177	77,177	0	77,137	28,941	77,130
Baker	30,871	30,871	0	30,455	11,577	30,871
Central Oregon	38,589	38,589	0	38,589	14,471	38,589
Deschutes	7,718	7,718	0	7,718	2,894	7,718
Jordan and Malheur	316,426	316,426	0	312,226	118,660	314,876
Lakeview	123,484	123,484	0	120,624	46,306	122,854
Three Rivers	177,508	177,508	0	177,508	66,565	177,347
Socioeconomic Study Area	771,773	771,773	0	764,257	289,414	769,385

Sources: Calculated based on data from BLM 2015

Table R-2
Estimated Billed Annual Animal Unit Months in GRSG Habitat by Alternative (High Scenario Does Not Include Adjustments for Loss of Seasonal Grazing Areas – Torell Adjustments)

Field Office	Initial	Alternatives A, B, E	Alternative C	Alternative D	Alternative F	Proposed Plan
High Impact Scenario						
Andrews	57,883	57,883	0	57,853	21,706	57,848
Baker	27,784	27,784	0	27,410	10,419	27,784
Central Oregon	21,996	21,996	0	21,996	8,248	21,996
Deschutes	4,168	4,168	0	4,168	1,563	4,168
Jordan and Malheur	256,305	256,305	0	252,903	96,115	255,050
Lakeview	85,204	85,204	0	83,231	31,951	84,769
Three Rivers	131,356	131,356	0	131,356	49,258	131,237
Socioeconomic Study Area	584,695	584,695	0	578,915	219,260	582,850
Low Impact Scenario						
Andrews	57,883	57,883	0	57,853	41,000	57,848
Baker	27,784	27,784	0	27,410	13,506	27,784
Central Oregon	21,996	21,996	0	21,996	21,996	21,996
Deschutes	4,168	4,168	0	4,168	4,168	4,168
Jordan and Malheur	256,305	256,305	0	252,903	156,236	255,050
Lakeview	85,204	85,204	0	83,231	70,231	84,769
Three Rivers	131,356	131,356	0	131,356	95,410	131,237
Socioeconomic Study Area	584,695	584,695	0	578,915	402,547	582,850

Sources: Calculated based on data from BLM 2015

to seasonal limitations of grazing areas. This would be the case if livestock operations have no reasonable alternative to seasonal grazing on public lands. Livestock grazing on federal lands is often done during the spring and summer seasons, with other feeding alternatives (hay) being used during fall and winter. If there are no grazing alternatives to federal lands during spring and summer, farmers may need to reduce their operations and the resulting loss of output,

jobs, and earnings would be larger than currently estimated. Torell et al. (2014) provides estimates of the potential impacts to a model ranch in Oregon of seasonal closures of federal lands for cattle grazing. These estimates show the total number of AUMs lost for each AUM lost on BLM lands under various scenarios. These scenarios range from a 25 percent reduction in BLM AUMs to a complete elimination of AUMs on BLM lands with the livestock operation going out of business. The estimates are based on an economic model that assumes farmers respond to the loss of availability of federal lands for grazing in several ways to maximize their profits (gross margins), including reducing the size of their operations. Based on the Torell et al. (2014) estimates, BLM assumed that for each BLM AUM lost under Alternative C, an additional 1.44 AUMs would be lost for a total of 2.44 AUMs lost (mid-point between the scenarios of 100 percent loss of BLM AUMs with and without closure of operations). Under Alternative D and the Proposed Plan, no additional AUMs would be lost, because the loss in BLM AUMs would be less than 1 percent of the total. Under Alternative F, 0.45 additional AUMs would be lost for each reduction of BLM AUMs for a total of 1.45 AUMs (mid-point of scenarios of loss of 50 percent of AUMs on BLM lands and scenario of loss of 75 percent of AUMs on BLM lands). These AUM adjustment factors are based on a model Oregon ranch that relies on a total of approximately 7,500 AUMs, of which 2,400 AUMs (32%) are linked to federal land. These factors were applied only to cattle AUMs, because no similar estimate was available for sheep. In **Tables R-2** and **R-3** these factors are referred to as "Torell Adjustments."

For the low impact scenario, livestock operators would continue to bill AUMs at the observed level as long as there are enough active AUMs to do so. In other words, the stocking rate would increase if necessary to keep billed AUMs constant. If active AUMs were not reduced beyond the initial amount of billed AUMs, livestock operators would continue to bill the same amount of AUMs, resulting in no impact. If active AUMs were reduced beyond the initial amount of billed AUMs, ranchers would use all of the reduced active AUMs. Thus, when the number of reduced active AUMs was less than number of the initial billed AUMs, the analysis used the number of reduced active AUMs as the number of reduced billed AUMs under each alternative. Otherwise, the analysis assumed no change in the number of billed AUMs.

Table R-3 shows the two scenarios for resulting AUM reductions, calculated as the difference between the initial billed AUMs and the reduced billed AUMs under each alternative. AUMs are distinguished between those allocated to sheep and those allocated to cattle and other animals, to allow different valuation of forage, as explained further below[1].

[1] Note that if livestock operators followed the NRCS stocking rate guides and utilization were 50 percent of active AUMs under all alternatives, the impacts of the action alternatives would tend to be reduced, given that utilization under current management would actually be less than observed.

Table R-3
Estimated Reduction in Annual Animal Unit Months by Alternative and Livestock Type (High Scenario Includes Adjustments for Loss of Seasonal Grazing Areas – Torell Adjustments)

Field Office	High Impact Scenario					Low Impact Scenario				
	Alts. A, B, E	Alt. C	Alt. D	Alt. F	Proposed Plan	Alts. A, B, E	Alt. C	Alt. D	Alt. F	Proposed Plan
Total										
Andrews	0	0	-141,212	-30	-52,453	-35	0	-57,884	-30	-16,883
Baker	0	0	-67,509	-374	-25,123	0	0	-27,784	-374	-14,278
Central Oregon	0	0	-53,011	0	-19,805	0	0	-21,996	0	0
Deschutes	0	0	-10,170	0	-3,777	0	0	-4,168	0	0
Jordan and Malheur	0	0	-620,782	-3,402	-231,377	-1,256	0	-256,305	-3,402	-100,070
Lakeview	0	0	-207,896	-1,973	-77,216	-435	0	-85,203	-1,973	-14,973
Three Rivers	0	0	-320,363	0	-119,014	-119	0	-131,357	0	-35,946
Socio-economic Study Area	0	0	-1,420,941	-5,780	-528,765	-1,845	0	-584,696	-5,780	-182,149
Cattle and Other										
Andrews	0	-141,195	-30	-52,442	-35	0	-57,867	-30	-16,878	-35
Baker	0	-67,312	-372	-25,000	0	0	-27,587	-372	-14,176	0
Central Oregon	0	-52,553	0	-19,519	0	0	-21,538	0	0	0
Deschutes	0	-10,170	0	-3,777	0	0	-4,168	0	0	0
Jordan and Malheur	0	-617,586	-3,360	-229,380	-1,243	0	-253,109	-3,360	-98,822	-1,243
Lakeview	0	-207,896	-1,973	-77,216	-435	0	-85,203	-1,973	-14,973	-435
Three Rivers	0	-320,260	0	-118,950	-119	0	-131,254	0	-35,918	-119
Socio-economic Study Area	0	-1,416,971	-5,735	-526,283	-1,832	0	-580,726	-5,735	-180,766	-1,832
Sheep										
Andrews	0	-17	0	-11	0	0	-17	0	-5	0
Baker	0	-197	-3	-123	0	0	-197	-3	-101	0
Central Oregon	0	-458	0	-286	0	0	-458	0	0	0
Deschutes	0	0	0	0	0	0	0	0	0	0
Jordan and Malheur	0	-3,196	-42	-1,998	-13	0	-3,196	-42	-1,248	-13
Lakeview	0	0	0	0	0	0	0	0	0	0
Three Rivers	0	-103	0	-64	0	0	-103	0	-28	0
Socio-economic Study Area	0	-3,971	-45	-2,482	-13	0	-3,971	-45	-1,382	-13

Sources: Calculated based on data from BLM 2012 and BLM 2015

The economic value of forage is estimated based on the value of production associated with the forage. Values for cattle and sheep are estimated separately, with the value of forage for other animals is considered equivalent to the value for cattle. Due to price fluctuations, average per-AUM values for cattle and sheep are based on the 2002 to 2011 average value of production estimates from the (US Department of Agriculture, Economic Research Service 2012). The value for cattle is $50.37 per AUM in the primary Socioeconomic Study

Area, and the value for sheep is $57.20 per AUM in the primary Socioeconomic Study Area (in 2010 dollars). Including indirect and induced impacts, the value of one AUM in the primary Socioeconomic Study Area is $96.18 for cattle and is $119.39 for sheep (in 2010 dollars). **Table R-4** shows the economic impact assumptions for cattle and sheep. The direct economic impact is the estimated change in livestock output per AUM; IMPLAN generates the indirect and induced impacts.

Table R-5 provides a summary of the employment impacts that would result, according to IMPLAN, based on unit changes in livestock AUMs.

Table R-4
Assumptions for Analysis of Impacts on Output for Livestock Grazing

Economic Impact	Cattle	Sheep
Primary Study Area		
Direct Economic Impact ($/AUM)	$50.37	$57.20
Indirect Economic Impact ($/AUM)[1]	$40.67	$54.24
Induced Economic Impact ($/AUM)[2]	$5.14	$7.95
Total Economic Impact ($/AUM)	$96.18	$119.39
Multiplier (Total Impact/Direct Impact)	1.91	2.09
Primary and Secondary Study Area		
Direct Economic Impact ($/AUM)	$50.37	$57.20
Indirect Economic Impact ($/AUM)[1]	$41.76	$55.90
Induced Economic Impact ($/AUM)[2]	$5.69	$8.77
Total Economic Impact ($/AUM)	$97.82	$121.87
Multiplier (Total Impact/Direct Impact)	1.94	2.13

Note: All dollar values are in 2010 dollars.
[1] Indirect impacts reflect increased demand in sectors that directly or indirectly provide supplies to the livestock industry.
[2] Induced impacts reflect increased demand in the consumer and government sectors.

Table R-5
Assumptions for Analysis of Employment Impacts for Livestock Grazing

Employment Impact	Cattle	Sheep
Primary Study Area		
Direct Employment (Jobs/1,000 AUMs)	0.000559	0.000980
Indirect Employment (Jobs/1,000 AUMs)	0.000445	0.000957
Induced Employment (Jobs/1,000 AUMs)	0.000051	0.000075
Total Employment (Jobs/1,000 AUMs)	0.001055	0.002013
Multiplier (Total Impact/Direct Impact)	1.89	2.05
Average Earnings per Job (2010 dollars)	$31,791	$17,530
Primary and Secondary Study Area		
Direct Employment (Jobs/1,000 AUMs)	0.000559	0.000980
Indirect Employment (Jobs/1,000 AUMs)	0.000461	0.000980
Induced Employment (Jobs/1,000 AUMs)	0.000056	0.000081
Total Employment (Jobs/1,000 AUMs)	0.001076	0.002042

Table R-5
Assumptions for Analysis of Employment Impacts for Livestock Grazing

Employment Impact	Cattle	Sheep
Multiplier (Total Impact/Direct Impact)	1.93	2.08
Average Earnings per Job (2010 dollars)	$31,767	$17,730

Note: Direct, indirect, and induced employment impacts and average earnings per job are calculated using IMPLAN.

Output, labor, and earning impacts summarized in **Table 4-50** in the economic impact section of the EIS are presented as lower and upper bound impacts. Estimates of lower bound impacts are equal to the 'low impact scenario' reductions in AUMs in **Table R-3** multiplied by impact multipliers in **Tables R-4** and **R-5**; calculations are performed for cattle and sheep separately and then added together. Estimates of upperbound impacts are equal to the 'high impact scenario' reductions in AUMs in **Table R-3**, and multiplied by multipliers in **Tables R-4** and **R-5** in a similar manner, noting that the high impact reductions in AUMs include the Torell production adjustment factors as described earlier (Torell adjustment factors are not available for sheep).

The IMPLAN sectors used to model an exogenous change in demand for livestock grazing were the following (IMPLAN sector numbers are shown in brackets): grain farming (2), all other crop farming (10), support activities for agriculture and forestry (19), residential structures maintenance and repairs (40), wholesale trade (319), truck transportation (335), banking (354), real estate (360), accounting (368), veterinary services (379), equipment repair and maintenance (417), and labor income (NA). Cattle grazing used the following additional sector: cattle ranching and farming (11). Sheep grazing used the following additional sectors: animal production except cattle and poultry and eggs (14) and retail-food and beverages (324).

GEOTHERMAL EXPLORATION AND DEVELOPMENT

Economic impacts from geothermal exploration and development are a function of construction and operation expenditures for geothermal electricity development, including drilling wells (exploratory, production, and injection), constructing power plants, and operating facilities.

To estimate economic activity associated with geothermal development, BLM first used the National Renewable Energy Laboratory's Jobs and Economic Development Impact (JEDI) model (NREL, 2012) to determine approximate capital and operating costs associated with a representative power plant. The assumptions used a 50 MW nameplate capacity and typical conditions for the planning area: a resource at about 300 degrees Fahrenheit at a depth of 3,000 feet; binary cycle; and 1.93 production wells per injection well. BLM used standard assumptions from the National Renewable Energy Laboratory for the local share of construction and operating expenses that would be spent within the state of Oregon, as an approximation for the study area (local spending

assumptions were available at the state level but not the county level). BLM then used IMPLAN, calibrated to the specific region of the Socioeconomic Study Area, to calculate indirect and induced impacts associated with a given direct expenditure. **Table R-6** shows the resulting assumptions for construction and operation of an individual power plant.

Table R-6
Assumptions for Analysis of Impacts on Output for Geothermal Exploration and Development

	Traditional Hydrothermal Plant (millions of 2010 dollars)
Construction	
Direct Economic Impact[1]	$35.78
Indirect Economic Impact[2]	$2.83
Induced Economic Impact[3]	$8.40
Total Economic Impact	$47.02
Multiplier (total impact/direct impact)	1.31
Operation	
Direct Economic Impact[1]	$2.25
Indirect Economic Impact[2]	$0.00
Induced Economic Impact[3]	$1.17
Total Economic Impact	$3.42
Multiplier (total impact/direct impact)	1.52

Notes: Details may not add to total due to rounding.
[1]Direct economic impact is the average expenditure per plant, assuming a nameplate capacity of 50 MW.
[2]Indirect impacts from IMPLAN reflect increased demand in sectors that directly or indirectly provide support for the geothermal exploration and development industry.
[3]Induced impacts from IMPLAN reflect increased demand in the consumer and government sectors (e.g., employee wages).

Table R-7 provides a summary of employment impacts according to IMPLAN results, based on construction and operations.

Output, labor, and earning impacts summarized in **Table 4-52** in the economic impact section of the EIS are presented for construction and operations of geothermal wells. Impacts during construction are equal to the average annual MW installed per year multiplied by impact multipliers in **Tables R-6** and **R-7**. Estimates of impacts during operations are equal to the average annual MW in operation multiplied by the multipliers in **Tables R-6** and **R-7**. These estimates assume only a share of the wells drilled produce and about half of the production wells are producing by year 5. Impacts are estimated by multiplying the number of wells producing by the multipliers in **Tables R-6** and **R-7**.

The IMPLAN sectors used to model an exogenous change in demand for geothermal development were the following (IMPLAN sector numbers are shown in brackets): drilling oil and gas wells (28), support activities for oil and gas operations (29), construction of new manufacturing structures (35),

Table R-7
Assumptions for Employment Impact Analysis for Geothermal Exploration and Development Activities

	Traditional Hydrothermal Plant (number of jobs per plant)
Construction	
Direct Employment	243.7
Indirect Employment	224.8
Induced Employment	81.1
Total Employment	549.6
Multiplier (Total Impact/Direct Impact)	2.26
Average Earnings per Job (2010 dollars)	$34,899
Operation	
Direct Employment	17.0
Indirect Employment	0.0
Induced Employment	11.0
Total Employment	28.0
Multiplier (Total Impact/Direct Impact)	1.65
Average Earnings per Job (2011 dollars)	$91,759

Note: Direct, indirect, and induced employment impact and average earnings per job are calculated using IMPLAN, as described in the text.

nonresidential maintenance and repair (39), wholesale trade (319), retail – food and beverages (324), truck transportation (335), commercial and industrial equipment leasing (365), architectural and engineering services (369), environmental and consulting services (375), miscellaneous professional/scientific/technical services (380), and labor income change (NA).

WIND ENERGY

The economic impact of wind energy depends on the expenditures made with installation and operations of wind farms. Expenditures made in the primary Study Area were estimated based on the amount of electricity (nameplate capacity in megawatts, MW) projected under each alternative, and the installation and operations costs per MW.

Although there are many locations in the Study Area where wind development is feasible, these locations may or may not overlap with sage-grouse habitat. For the purposes of IMPLAN analysis, BLM considered that two currently existing applications for wind development in the Burns District (Harney County) would no longer occur under Alternatives B, C, F, and the Proposed Plan, both projects being in PGMA, with some of the associated transmission lines and access roads in PPMA. These two projects are estimated to have, when completed, 182 MW of installed capacity. For the purposes of IMPLAN analysis only, BLM assumed that construction would be distributed over a 10-year period.

Installation and operation costs per MW were obtained from default values for the State of Oregon used by the JEDI (Jobs and Economic Development Impact) model. The JEDI model for wind energy was developed by the National Renewable Energy Laboratory, and default values for construction and operation costs per MW were determined based on extensive interviews with power generation project developers, state tax representatives, and others in the appropriate industries (NREL 2012). Default values were based on projects of 100 MW (50 turbines of 2,000 kilowatts each) and were estimated to be, in 2008 dollars, $2,000 per kilowatt for installed project costs and $20 per kilowatt for operations and maintenance costs.

Tables R-8 and **R-9** below show the estimated multipliers for output and employment during installation and operations in the primary study area, primary and secondary study area, and in Harney County, where two proposed wind energy projects were analyzed.

Output, labor, and earning impacts summarized in **Table 4-53** and **Table 4-54** in the economic impact section of the EIS are presented for construction and operations of wind energy projects. Impacts during construction are equal to the average MW of construction multiplied by impact multipliers in **Table R-8**. Estimates of impacts during operations assume half of the MW are installed and in production by year 5. Impacts are estimated by multiplying the number of wells producing by the multipliers in **Table R-9**.

Table R-8
Assumptions for Analysis of Impacts on Output for Wind Energy

Economic Impact	Primary Study Area	Primary and Secondary Study Area	Harney County
Installation			
Direct Economic Impact ($/MW)	$299,358	$299,358	$305,780
Indirect Economic Impact ($/MW)[1]	$40,823	$46,811	$4,990
Induced Economic Impact ($/MW)[2]	$41,212	$44,476	$14,712
Total Economic Impact ($/MW)	$381,393	$390,645	$325,482
Multiplier (Total Impact/Direct Impact)	1.27	1.30	1.06
Operations			
Direct Economic Impact ($/MW)	$11,727	$11,727	$11,978
Indirect Economic Impact ($/MW)[1]	$276	$311	$179
Induced Economic Impact ($/MW)[2]	$3,260	$3,433	$2,386
Total Economic Impact ($/MW)	$15,263	$15,471	$14,544
Multiplier (Total Impact/Direct Impact)	1.30	1.32	1,21

Source: IMPLAN. Note: All dollar values are in 2010 dollars.
[1] Indirect impacts reflect increased demand in sectors that directly or indirectly provide supplies to the installation and operations of wind farms.
[2] Induced impacts reflect increased demand in the consumer and government sectors.

Table R-9
Assumptions for Analysis of Impacts on Employment for Wind Energy

Employment Impact	Primary Study Area	Primary and Secondary Study Area	Harney County
Installation			
Direct Employment (jobs/MW)	1.69	1.69	1.1
Indirect Employment (jobs/MW)	0.28	0.28	0.06
Induced Employment (jobs/MW)	0.40	0.43	0.14
Total Employment Impact (jobs/MW)	2.37	2.43	1.29
Multiplier (Total Impact/Direct Impact)	1.40	1.44	1.17
Average Earnings per Job (2010 dollars)	$44,577	$44,514	$38,796
Operations			
Direct Employment (jobs/MW)	0.15	0.15	0.15
Indirect Employment (jobs/MW)	<0.01	<0.01	<0.01
Induced Employment (jobs/MW)	0.03	0.03	0.02
Total Employment Impact (jobs/MW)	0.19	0.19	0.18
Multiplier (Total Impact/Direct Impact)	1.23	1.25	1.16
Average Earnings per Job (2010 dollars)	$45,302	$45,164	$45,888

Source: IMPLAN. Note: All dollar values are in 2010 dollars.
[1] Indirect impacts reflect increased demand in sectors that directly or indirectly provide supplies to the installation and operations of wind farms.
[2] Induced impacts reflect increased demand in the consumer and government sectors.

The IMPLAN sectors used to model an exogenous change in demand for wind energy development were the following (IMPLAN sector numbers are shown in brackets): sand and gravel mining (26), ready-mix concrete manufacturing (161), wholesale trade (319), retail-building materials and garden supply (323), hotels and motels (411), food services and drinking places (413), and labor income change (NA). In the case of wind energy operations, the IMPLAN sectors used were the following: electrical power (31), nonresidential maintenance and power (39), wholesale trade (319), retail – motor vehicle and parts (320), retail – building materials and garden supply (323), retail – gasoline stations (326), other state and local government enterprises (432), labor income change (NA), state and local government – non-educational (NA), and local government – educational (NA). Unlike other sectors modeled in IMPLAN for this EIS, the state and local government sector was included when modeling wind energy operations following the NREL JEDI model on which the model for this EIS was based.

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