Appendix 1. Economic Contribution Estimates

Introduction

Table A1-1 presents information on economic contributions, value added, and employment associated with Interior's activities for Fiscal Year 2012. Economic contributions are a measure of the cumulative effects of spending as it cycles through the economy.[97] Value added is the contribution of an activity to overall Gross Domestic Product (GDP)[98] and equals the difference between an industry's gross output (e.g., sales or receipts and other operating income, commodity taxes, and inventory change) and the cost of its intermediate inputs (including energy, raw materials, semi-finished goods, and services that are purchased from all sources). These economic measures should not be confused with measures of economic benefits or net economic effects resulting from Interior's activities or policies Interior has implemented. The distinction between economic contributions or impacts and economic benefits as well as the limitation associated with an economic contribution analysis are discussed in greater detail in the sections that follow.[99]

Economic Contributions vs. Economic Benefits

The analysis conducted for this report estimating the total output, value added, and jobs supported from Interior's activities is classified an economic contributions analysis, which is a descriptive analysis of how expenditures from a policy, program or event cycle through the economy. The results of an economic contributions analysis should not be equated to or described similarly as an analysis that measures net economic benefits. Net economic benefits are a measure of the extent to which society is better (or worse) off because of a given policy, program or event, where net economic benefits can include measures of both market and non-market values. Economic contributions analysis typically relies on Input-Output (I/O) models to estimate total output, value added, and jobs supported by the flow of expenditures through the economy. Conversely, an analysis of net economic benefits relies on market-based valuation methods as well as non-market valuation methods (e.g., revealed preference and stated preference methods) to derive monetary estimates of benefits and costs to determine the net economic benefits to society (i.e., benefits minus costs) from a policy or resource management decision.

The uses for economic contributions analysis and net economic benefits analysis differ substantially. From an economics perspective, the goal of natural resource policy management is to implement

[97] For additional information on economic contribution and economic impact analysis, see: Watson, P., J. Wilson, D. Thilmany, and S. Winter. 2007. Determining Economic Contributions and Impacts: What is the difference and why do we care? *The Journal of Regional Analysis and Policy*, 37(2): 140-146.

[98] The components of value added consist of compensation of employees, taxes on production and imports less subsidies, and gross operating surplus. GDP measures the value of the goods and services produced by the U.S. economy in a given time period.

[99] One of the important limitations is that contribution analysis is a static approach and does not incorporate potential price changes over time or other shifts in labor or capital resources as a result of changes in the scale or scope of economic activities. A different type of modeling approach (computable general equilibrium models) would be necessary to incorporate price changes and other economy wide resource shifts.

policies or management options where the benefits to society exceed the costs and therefore, enhance social welfare. Because an economic contributions analysis simply tracks how expenditures from a policy, program, or event flow through the economy, it does not provide insight into potential economic benefits and whether the expenditures lead to the enhancement of societal welfare. However, the results of an economic contributions analysis can still help decisions makers understand how different sectors of the economy may be impacted by the expenditures associated with a policy, program or event. A determination of whether social welfare is enhanced requires further analysis of the changes in the economic values of the flow of environmental goods and services affected by a policy, program or event and how the resulting changes in economic values compare to the expenditures incurred. Additional discussion about the measurement of economic contributions and economic values is provided in the sections that follow.

Estimating Economic Contributions

An analysis of economic contributions is commonly done with the use of Input-output models (I/O). I/O models are economic models used to provide a snapshot of the level of economic activity at a given point in time for a defined geographic area, which can be a county, group of counties, state, region, or the entire nation. I/O models are constructed to capture the complex interactions of consumers and producers of goods and services in the economy, such that goods produced by one sector of the economy become inputs of another, and the goods produced by that sector can become inputs to yet other sectors. Thus, a change in the demand for a good or service can generate a ripple effect throughout the economy and I/O models are constructed to measure this effect.

Due to the way industries interact within an economy, activity in one industry can affect activity in several other industries. In terms of I/O models, spending associated with one industry or sector of the economy can directly affect levels of activity in another industry or sector. In turn, those industries that are directly affected can then indirectly affect additional industries or sectors due to how their activity is affected. For example, when visitors come to an area to visit a park or historic site these visitors spend money to purchase various goods and services. Local businesses will purchase labor and supplies to meet the demand for these goods and services. The income and employment resulting from the visitor purchases of goods and services from local businesses represent the *direct* effects of visitor spending within the economy. More formally, the *direct* effects measure the amount of spending that stays in the local economy after the first round of spending; the amount that doesn't stay in the local economy is termed a *leakage* (Carver and Caudill, 2007). In order to provide supplies to local businesses for the production of their goods and services, input suppliers must also purchases inputs from other industries. The income and employment resulting from these secondary purchases by input suppliers are the *indirect* effects of visitor spending within the economy. Additionally, employees of the directly affected businesses and indirectly affected input suppliers use their incomes to purchase goods and services. The resulting economic activity from the employee income is the *induced* effect of visitor spending. The indirect and induced effects are also known as the secondary effects of visitor spending.

In general, I/O models rely on "multipliers" that mathematically represent the relationship between a change in one sector of the economy (e.g., expenditures by recreationists) and the effect of that change on economic output, income, or employment in other sectors of the economy (e.g., suppliers of goods and services to recreationists). Multipliers developed from I/O models vary by economic sector and the geographic area of analysis (i.e., they are not same if one is looking at the local, state, regional, or national level).

This analysis primarily employs the widely used I/O software and data system known as IMPLAN for estimating the economic contribution of Interior activities in terms output (sales), value added, and employment (jobs). In particular, this analysis uses IMPLAN Version 3.0, which was released in November 2009 and replaced IMPLAN Version 2.0 that was released over ten years prior.[100] The underlying data drawn upon by the IMPLAN software is collected by the Minnesota IMPLAN Group (MIG) from multiple Federal and state sources including the Bureau of Economic Analysis, Bureau of Labor Statistics, and the U.S. Census Bureau. Additional information about the IMPLAN modeling software can be found at: http://implan.com/V4/Index.php.

To determine the economic contributions of Interior activities, the IMPLAN modeling software was used to derive the following multipliers to capture the resulting secondary effects (i.e., indirect and induced effects):

- **Total Industry Output** – The value of all sales to intermediate (business to business) and final demand (consumers, exports).
- **Value Added** – The difference between an industry's gross output (e.g., sales or receipts and other operating income, commodity taxes, and inventory change) and the cost of its intermediate inputs (including energy, raw materials, semi-finished goods, and services that are purchased from all sources)
- **Employment** – Defined as average annual employment, which includes full and part time, temporary, and seasonal jobs as well as multiple jobs held by a single person. Jobs do *not* equal Full Time Equivalents.[101]

[100] IMPLAN Version 3.0 incorporated a number of changes, with one of the most notable being an improvement in the method used for calculating Regional Purchase Coefficients (RPCs). IMPLAN Version 2.0 had been criticized for its use of non-survey based RPCs, which have been shown to produce higher estimates than survey-based data. IMPLAN Version 3.0 attempts to deal with these criticisms through an improved method for estimating RPCs. The new method uses a gravity model that considers the size and proximity of alternative markets to give an improved estimation of imports and exports than the econometric-based estimates in Version 2.0. A study by Koontz, Loomis, and Winter (2011) showed that the differences in the IMPLAN Version 3.0 software can result in lower estimates of employment and income effects for tourism impacts.

[101] A job in IMPLAN is the annual average of monthly reports for that industry. This is the same definition used by CEA, BLS, and BEA nationally. One 12-month job is equivalent to two 6-month jobs. The employment data come from a series of surveys taken multiple times each year. The workers are counted regardless of status, thus jobs are permanent, part time, temporary and seasonal. The data from the surveys are summed and averaged to obtain an "average annual employment."

Unless otherwise noted, this economic contribution analysis uses state-level multipliers to develop the output, value added and employment impacts that occur within each state's borders. A multiplier for one state does not account for "spillover" effects accruing in other states. Thus, the sum of effects across 50 states will be less than the overall nationwide impacts. In contrast, when a national-level multiplier is used, spillover effects among states are taken into account, providing a better estimate of nationwide impacts.

When using multipliers (or response coefficients), the following should be kept in mind:

- Multipliers are not generic and reflect a unique underlying economic structure. They are not, therefore, generally applicable to issues and geographies different from those under which they were originally estimated.
- In reality, estimated job and income effects would be "lumpy". Multipliers generated for large geographic areas may contain well developed and complex economies. At a smaller scale, investments in rural, simple economies would necessarily have smaller multipliers and thus a smaller job and income response.
- IMPLAN is used to examine "marginal" changes. Estimated jobs and income multipliers are valid only for relatively small changes to a particular area's economy. Any stimulus large enough to change the underlying structure and trade relationships of the economy will necessarily change the relationships quantified in the multipliers and new models would need to be specified and estimated.
- Alternative modeling approaches, such as computable general equilibrium modeling (CGE), are more appropriate when activities or policies are anticipated to affect prices or to result in shifts in the allocation of labor and capital. CGE modeling builds on structural assumptions about how an economy works generally. CGE modeling may be the only way to understand important indirect effects and are important when non-marginal changes are under consideration. Factor prices, input prices, output prices, household incomes, and government taxes in a CGE model are all allowed to interact. Furthermore, a CGE model can help determine winners and losers as a result of specific changes, and provide measures of welfare changes induced by policy changes. An important limitation to the use of CGE models is that they are a data and time intensive technique that requires a high level of skill. Strong underlying assumptions about the structure of the economy can also drive the results of CGE models.[102]

[102] CGE models typically require extensive information on benchmark values for prices, rents and elasticities, where these values can come from partial equilibrium studies. CGE models are not suitable for estimating these initial values, but rather for exploring how these values change.

Table A1-1. Estimated Economic Contributions Resulting from Interior's Activities

Category	Direct Economic Contribution (billions, $2012)	Total Economic Contributions (direct+indirect+induced) (billions, $2012)	Value Added (billions, $2012)	Total Domestic Jobs Supported
DOI Payroll*	5.14	7.85	3.88	54,886
Grants & Payments to non-Federal Entities (excludes payments via U.S. Treasury)	4.74	11.0	7.95	89,112
Support for Tribal Governments	0.58	1.21	0.84	10,549
Public Resources as Inputs to Production				
Recreation and Tourism	19.18	44.83	24.70	372,361
Energy				
Oil, gas and coal	94.02	230.0	131.06	1,235,989
Hydropower	1.46	2.15	1.71	6,705
Wind Power	0.00	0.08	n/a	466
Geothermal	0.17	0.49	0.33	2,539
Solar		1.69	n/a	8,423
Non metallic minerals, other minerals, and hardrock minerals	8.52	21.06	13.04	110,531
Other Production				
Irrigation water	17.80	43.07	23.09	315,014
M&I water	2.33	4.29	3.75	23,494
Grazing	0.59	1.56	n/a	18,777
Timber	0.06	1.41	0.55	7,105
Total	154.58	370.68	210.91	2,255,951

* Economic contributions, value added and jobs supported are related to consumption expenditures by about 81,000 employees in 2012

Estimating Economic Value

Interior's land and managed resources produce a wide range of valuable goods and services, including food, energy, drinking water, flood and disease control, carbon storage, recreation, and access to areas of cultural importance. Many of the land and resource management decisions facing the Department involve questions of trade-offs and an understanding of economic values associated with the available management options. For example, the Klamath Secretarial Determination required the Secretary of the Interior to determine whether removal of four dams on the Klamath River will help restore salmonid fish to the Klamath Basin, and whether dam removal is in the public interest. Therefore, one component of the evaluation process can be described as trying to answer the question of whether the benefits of dam removal (primarily affecting the natural resources and users of the Klamath River Basin) outweigh the costs of removing the four dams. Making such an evaluation requires an understanding of the economic values of the Klamath River Basin resources and the trade-offs people would make if the dams were removed versus leaving them in place.

For some of the environmental goods and services provided from Interior managed lands, determining their economic value is relatively straightforward, such as for minerals or timber, which are traded in established markets. Other goods and services are being valued in emerging markets, such as carbon sequestration and alternative energy, which are expected to become better defined in coming years. However, explicit markets do not necessarily exist for determining the economic value for experiencing a day of hiking or fishing, maintaining and interpreting our cultural resources, enhancing the health of wetlands and rangelands, or preserving habitat for endangered species. The economic values of nonmarket environmental goods and services are also important to consider in decision making, but are less well understood than the economic value of the marketed goods and services provided by Interior-managed lands and resources.

The economic values derived from an environmental good or resource can be conceptually divided into use and nonuse values, such that total economic value is equal to the sum of use and nonuse values. Use values can be direct or indirect, arising from the exchange or consumption of marketed goods and services (e.g., oil production), while other use values can be derived from nonmarket activities (e.g., recreational fishing or hunting). In turn, nonuse values are thought to capture the preferences for environmental goods and services not linked directly to their (immediate) use or consumption. Specific to Interior's activities, these preferences could include a desire to preserve the functioning of specific ecosystems for the benefits of plants and animals, a desire to preserve specific lands to maintain the option for future use, and a sense of responsibility or stewardship towards preservation of culture or areas of historic importance.

Estimating economic values associated with the numerous environmental goods and services provided by Interior-managed lands requires the use of market and nonmarket valuation methods. Market valuation methods rely on information and data about goods traded in established markets to determine economic value. This approach applies to minerals, timber, grazing, etc. However, as noted earlier, many goods and services provided by Interior-managed lands and resources do not have an

established market and estimating their economic value requires the use of nonmarket valuation methods.

Broadly speaking, nonmarket valuation methods can be classified into revealed preference (RP) methods and stated preference (SP) methods. RP methods rely on observations of individual behavior to infer values of environmental goods and service, while SP methods rely on individuals' statements about their intended behavior or expression of value under future conditions or scenarios. RP methods are only able to capture values associated with use values (direct or indirect) under conditions (including environmental resource conditions) that have actually occurred. The implicit assumption behind RP methods is that the environmental good or service being valued has a link to choices individuals made, and values are revealed through these choices. For example, some people value open space and an individual may reveal their demand for open space in their housing choice. However, we only observe the sale price of a house and not the contribution of the individual housing characteristics to the total price of the house. Nevertheless, the economic value of protected open space can be inferred by economic models using the housing decisions of many individuals and controlling for the numerous factors that affect the sale price of a house (including proximity to protected open space).[103]

In contrast, SP methods are able to capture both use and nonuse values and can be used to value environmental resource conditions that have not been experienced by respondents. SP methods rely on carefully designed and worded surveys to elicit the preferences of the public. Because nonuse values, by definition, cannot be revealed from observed behavior, estimation of nonuse values requires the use of SP methods. Types of SP methods include contingent valuation (CV) and conjoint analysis (or contingent choice or ranking). Although there continues to be debate about SP methods, particularly as applied to estimation of nonuse values, SP methods have been used in various settings to help inform public policy decision making.[104]

The results from the types of economic valuation studies described above can provide reliable estimates of use and nonuse values for environmental goods and services, which can serve as valuable inputs into benefit-cost analyses, environmental impact assessments, policy decisions, and natural resource damage assessments. As such, these types of studies can supply decision makers with a rich set of information, allowing consideration of net benefits (total benefits minus total costs) associated with the numerous resource management choices faced by Interior.

[103] Types of revealed preference methods include the hedonic property method, hedonic wage method, random utility maximization, damage cost method, defensive behavior method, factor input method, and replacement cost method.

[104] Examples include the economic analysis conducted for the Secretarial Determination to remove four dams on the Klamath River; National Park Service's (NPS) evaluation of snowmobile regulations for the Greater Yellowstone Area; the Bureau of Reclamation's and NPS's assessment of the effects of the re-regulation of Glen Canyon dam on resources of the Grand Canyon; and natural resource damage assessments conducted for oil spills or hazardous substance releases.