U.S. Department of the Interior

Economic Report

FY 2012

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Executive Summary

The U.S. Department of the Interior plays an integral role in protecting America's natural resources and heritage, honoring our cultures and tribal communities, and supplying the energy to power our future. Interior's people, programs, and responsibilities impact Americans across all 50 states. The Department is the steward of 20 percent of the Nation's lands, managing national parks, national wildlife refuges, and public lands and assisting States, Tribes, and others in the management of natural and cultural resources. Interior grants access to public lands and offshore areas for renewable and conventional energy development—covering a quarter of the Nation's supplies of oil and natural gas—while ensuring safety, environmental protection and revenue collection for the American public. Interior oversees the protection and restoration of surface mined lands and is also the largest supplier and manager of water in the 17 Western States, assisting others with water conservation and extending water supplies and providing hydropower resources to power much of the Nation. The Department serves as Trustee to American Indians, Alaska Natives, and Native Hawaiians fulfilling essential trust responsibilities to tribal communities. The Department supports cutting edge research in geology, hydrology, and biology, informing resource management and community protection decisions at Interior and across the world.

This report represents the fourth in a series of annual economic reports initiated with a preliminary report released by Interior in December 2009. The report for FY 2012 includes chapters on recreation, conservation, energy, non-fuels minerals, and tribal economies as well as key outputs and trends associated with each output. The report also provides information on economic contributions and value added, employment supported, and economic values associated with some of the outputs produced on Interior land. Of the standard measures available, *value added* most accurately captures the dollar-value of Interior's resource-management activities.

A primary focus of the Department's activities is conservation. The Department of the Interior supports conservation efforts through public land and water resources administered by the Fish and Wildlife Service (FWS), the National Park Service (NPS), the Bureau of Land Management (BLM), and the Bureau of Reclamation (Reclamation). These areas provide opportunities for recreation visitors and support conservation of natural resources and wildlife habitat. The benefits provided by conservation are often measured in terms of the values they have to humans. Although these benefits are often difficult to quantify, techniques exist to estimate their value in monetary terms. Conservation lands managed and acquired by DOI serve many important biological and ecological functions such as the production of plant and animal species, provision of clean water, carbon storage, and scenic amenities. Many studies have estimated values for ecosystem services at specific locations.

Conservation investments can also contribute to local economies by providing employment opportunities and additional economic output. These metrics can be very important to communities, particularly in a difficult economic climate. The natural amenities supplied by conservation lands and open space also provide benefits to nearby landowners and residents. Previous studies have shown that natural amenities can lead to increased migration to surrounding localities. Natural areas have also been shown to increase the property values of surrounding home owners. For example, a recent study

showed a significant impact on the value of homes located near National Wildlife Refuges in certain areas of the country.

The FY 2012 value added and economic contribution associated with production and activities on DOI lands are estimated to be $211 billion and $371 billion, respectively. These outputs are estimated to have supported 2.3 million jobs in FY 2012. Information related to economic contributions, value added, employment, and other economic values associated with Interior's diverse activities is summarized below:

- **Recreation**: In FY 2012, Interior's lands hosted an estimated 417 million visits. The net economic value of a visit to Interior lands varies depending on the activity. For FY 2012, value added provided by visitors to Interior sites was estimated to be $24.7 billion, economic output was estimated to be $45 billion and about 372,000 jobs were supported.

Conservation Economics

Conservation investments provide value to society in terms of species and habitat protection, maintenance of working landscapes, the provision of ecosystem services, and human use benefits. Benefits obtained from conservation include stocks of natural capital (materials that exist at one point in time) and flows (services that are provided from the natural capital stock over time). Stocks of natural capital include resources such as minerals that can be depleted permanently and trees that are replenished slowly over time. Natural capital also produces a flow of benefits over time including water, air and climate regulation; nutrient cycling; cultural uses; and recreation opportunities. The human use of natural capital can affect stocks and flows of benefits provided over time.

- **Renewable Energy**: In FY 2012, Interior lands produced 47.5 TWh of hydropower. Also, in FY 2012, Interior approved the installation of 315 MW of wind capacity and 489 MW of solar power projects on public lands. Renewable energy activities were estimated to contribute $4.4 billion in output and support about 18,000 jobs. In aggregate, generating electricity by renewable energy reduces the amount of electricity supplied by fossil fuel plants, along with the associated emissions. Market values of power typically do not reflect these effects.
- **Conservation**: The value added, economic contributions, and employment supported by DOI's conservation related activities are difficult to isolate because conservation could be a component of recreation, ecosystem restoration, water management, and even some mineral development activities. Many of the benefits of nature to households, communities, and economies are not defined with a set of consistent metrics nor are they bought and sold in markets. This creates challenges in the valuation of these goods and services.

- **Restoration:** Every Interior bureau engages in some form of restoration from physical structures to ecological and human use resources. For example, BLM's Abandoned Mine Lands Program has compiled a database of nearly 40,000 sites to be restored, and the Office of Surface Mining Reclamation and Enforcement (OSM) has a target of 14,000 acres to be reclaimed from the effects of coal mining. The DOI Restoration Program works across bureaus to ensure that responsible parties – not taxpayers – bear the cost of restoring injured resources following a release of oil or other hazardous substances at hundreds of sites around the Nation, where nearly 100,000 acres and over 400 miles of stream and shoreline were restored in 2012. Restoration projects have significant economic impacts, which vary in scope depending on the extent and nature of the activities undertaken.
- **Fossil Fuel Energy:** In FY 2012, Interior-managed lands and waters produced 626 million barrels of crude oil, 5 tcf of natural gas, and 460 million tons of coal. Some average prices in FY 2012 included $94/bbl for oil, $2.66/mcf of natural gas, and $10 per ton of Powder River Basin coal. Oil, gas and coal produced from Interior lands were estimated to provide value added of $131.1 billion; estimated economic output contribution of $230 billion; and an estimated 1.2 million jobs. External costs are associated with the development of oil, gas, and coal produced from Interior lands, and with the production and the use of these resources. Market prices do not fully reflect these costs. Various regulations and other requirements designed to minimize adverse environmental impacts internalize some of these external costs.
- **Non-fuel (hardrock) minerals**: In FY 2012, Interior lands produced a wide variety of minerals. For example, it is estimated that over 3 million ounces of gold were produced from Federal lands; the average price of gold in 2012 was $1,700 per ounce. Non-fuel mineral production was associated with an estimated value added of $13 billion; estimated output of $21 billion; and estimated employment supported about 111,000 jobs. While minerals are generally traded in competitive markets (though some markets may be localized or thin), prices may not incorporate the external costs associated with mining. Nor does the Federal leasing system completely offset these costs, which are primarily associated with the environmental impacts of mining. Various regulations and other requirements designed to minimize adverse environmental impacts internalize some of these external costs.
- **Forage and Grazing**: In FY 2012, Interior lands produced nearly 9 million animal unit months (AUMs) of forage. Prices for forage range widely, from $1.35 to $17 per AUM. This production is associated with $1.5 billion in output and supported about 19,000 jobs. Forage prices do not fully reflect changes to various ecosystem service values provided by rangelands.
- **Timber**: In FY 2012, about 541,000 mbf of timber was harvested on BLM and tribal lands. This timber harvest was associated with about $554 million in value added, provided $1.4 billion in output, and supported about 7,100 jobs. Market prices do not fully reflect changes to various ecosystem service values provided by forest lands.
- **Water**: Interior stores and delivers water for irrigation, municipal and industrial (M&I), and other uses. The value of water varies widely according to location, type of use and climatic conditions. Interior's irrigation and M&I water activities are associated with $27 billion in value added; $47.4 billion in output; and supported an estimated 339,000 jobs. Interior also delivers water to support in-stream flows, wildlife refuges, and other uses that are difficult to fully value.
- **Scientific Data**: Scientific information is not typically valued in markets, and hence is underprovided by the private sector. Beyond helping Interior bureaus achieve their missions, scientific information (such as that produced by USGS) is an input to production processes and decisions that help promote economic growth and innovation and ensure American competitiveness in a global market.

- **Grants/Payments**: Grant and payment programs administered by Interior provided $7.95 billion in value added; economic contributions of $11 billion; and supported employment of 89,000. Within these totals:
    - Indian Affairs grants to support tribal governments provided value added of $0.8 billion, economic contributions of $1.2 billion, and supported employment of about 11,000.
    - Grants and payments to the Insular Affairs provided value added of $1.2 billion and supported employment of about 35,000.

Although estimates of value added and economic contributions provide important information on the effect of expenditures on outputs from Interior lands in local economies, there are additional economic values placed on DOI resources that are not captured in economic markets that would give a more complete picture of the impact of Interior's productive activities. For example, the full impacts would include the value individuals place on recreation above and beyond their expenditures, energy security, adverse changes associated with exploration, development, and production of minerals, and opportunities associated with water use. There are methods to value environmental goods and services, their estimation can be difficult and the estimation of these values for all of DOI's activities is outside the scope of this report.

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Chapter 1 Introduction and Overview

Background

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future. Interior's people and programs impact all Americans. The Department is the steward of 20 percent of the Nation's lands. Interior manages national parks, national wildlife refuges, and public lands and assists States, Tribes, and others in the management of natural and cultural resources. Interior provides access to public lands and offshore areas for renewable and conventional energy development—covering a quarter of the Nation's supplies of oil and natural gas—ensuring safety, environmental protection and revenue collection for the American public. Interior manages the protection and restoration of surface mined lands. The Department is the largest supplier and manager of water in the 17 Western States, assists others with water conservation and extending water supplies, and provides hydropower resources to power much of the Nation. The Department serves as Trustee to American Indians, Alaska Natives, and Hawaiian Natives.

The Department supports cutting edge research in geology, hydrology, and biology, informing resource management and community protection at Interior and across the world. In addition, through employment and educational opportunities offered by the Department, youth will have a key role in creating a new energy frontier, tackling climate change issues, empowering Native communities, improving our National Parks, enhancing wildlife habitat, and restoring our cultural and historic landmarks.[1]

In general, the U.S. economy continued to recover from the deep recession that began at the end of 2007.[2] The goods and services provided by the lands managed by DOI helped to support this economic recovery. These goods and services include outputs bought and sold in markets (e.g., such as oil and gas) as well as ecosystem goods and services that are not typically bought and sold in markets (such as clean water, recreation, habitat for fish and wildlife). Ecosystems (and their service flows) represent a special

[1] Interior has also benefited from government wide youth programs. In accordance with Executive Order 13562 signed December 27th 2010, the Pathways program eliminated previous student hiring authorities and established three new programs to engage youth in government service: the Internship Program, the Recent Graduates Program, and a reinvigorated Presidential Management Fellows (PMF) Program. For additional information see: http://www.opm.gov/HiringReform/Pathways/index.aspx.

[2] Real GDP increased 2.2 percent in 2012 (that is, from the 2011 annual level to the 2012 annual level), compared with an increase of 1.8 percent in 2011. In 2012, employment growth averaged 181,000 per month (http://bls.gov/news.release/empsit.toc.htm). GDP, or Gross Domestic Product, is a commonly used measure of economic performance and measures the value of the goods and services produced by an economy. "Real" measures reflect quantities independent of prices, allowing comparison of measures over periods in which prices have changed. GDP represents the market value of all final goods and services produced in a country, i.e., domestic value added which can be shown to be identical to the sum of payments to labor (i.e. salaries, wages and bonuses) plus payments to capital (i.e. profits). GDP is an imperfect measure of wellbeing or welfare for a variety of reasons.

form of wealth -- natural capital -- that humans depend on for a whole range of important benefits. While degraded or damaged ecosystems can sometimes be restored, in general, unlike skills, education, machines, etc., we cannot manufacture new natural capital.

Natural resources that are bought and sold in markets (e.g., oil, minerals, timber, forage, fish, etc.) contribute to a wide range of intermediate and final products. In addition, a substantial body of research over the past 30 years has demonstrated that people value the environment directly even where there is no market for environmental amenities.

The ecosystem services that are provided by Interior managed lands are typically provided free of charge, with the supply of those services often being influenced by a different set of individuals than those who benefit from the provision of the services. For example, a farmer who maintains wetlands and limits fertilizer application provides benefits of cleaner water and lower probability of flooding to downstream individuals. This mismatch between those who influence the supply of the services and those who benefit from the services can be characterized as a classic externality problem. Numerous potential solutions have been proposed for internalizing the externalities, including payments for ecosystem services, tradable development rights, taxes on activities that result in damages to services, and direct regulations.

Youth Employment

The Department of the Interior works to expand job opportunities, engagement and education for youth on our public lands and to facilitate partnerships and volunteer programs that leverage resources for accomplishing the Department's mission. Through Interior's youth programs and partnerships, in FY 2012 a total of 19,175 employment opportunities at Interior and organization partners were provided to young people between the ages of 15 and 25. Of this total, 12,579 were employed by DOI and 6,596 were employed by partners. The NPS and organizational partners employed the largest number in FY 2012, with a total of 7,837 youth employed. These programs and partnerships enable participating youth to gain valuable work experience that serves to strengthen their skills and knowledge base. Interior bureaus benefit from the many youth employment activities by being able to attract and retain qualified employees. Additionally, youth hires can often convert to permanent positions, be promoted to a new position, or receive new job assignments. In FY 2012, about 21% (over 2,650) of Interior's youth employees converted to permanent positions, were promoted to a new position, or received a new job assignment.

Some ecosystem services are traded in markets (e.g., commercial fisheries, timber, etc.) and valuation using market prices is relatively straightforward. But many ecosystem services are "public goods" that are not traded in markets and thus no market prices exist and in many instances market prices would not incorporate external costs or benefits. For services in this category, valuing ecosystem services can be complex. In general, valuation starts with defining an "ecological production function," that describes the structure and function of an ecosystem and the provision of various ecosystem services; and then translates the physical quantities of services into a common metric via the use of various valuation methodologies.

The value of some nonmarket ecosystem services has been well studied. For example, there are numerous empirical studies to assess the value of outdoor recreation and numerous applications of economic analysis being used to assess the value of various environmental amenities (access to open space, access to water resources, local air quality). These types of approaches are based on people's revealed preferences. A second type of valuation approach is known as stated preference estimation; this includes survey techniques to estimate people's valuation of an amenity. The strengths and weaknesses of applying both revealed and stated preference methods to value aspects of the environment are well understood. However, practical difficulties in assessing value in a manner that will be viewed as objective, authoritative, and accurate is difficult for some ecosystem services such as those services associated with cultural resources. This difficulty may argue for simply providing information about potential trade-offs among services without attempting to measure all services in the same metric.

The FY 2012 Report

This report represents the fourth in a series of annual reports initiated with a preliminary report released by Interior in December 2009. This chapter presents an overview of the key outputs produced by the Department. The chapter also provides a summary of Interior's economic contributions and value added, employment supported, and economic values associated with some of the outputs. Subsequent chapters on energy, non-fuels minerals, recreation, conservation, and tribal economies provide more detailed economic information on the key outputs and trends associated with each output.

This report differs from the previous reports in several respects: 1) it presents additional information on the physical and biological "outputs" produced by Interior; and 2) it presents additional information on economic "value added." *Gross output*, which represents the value of industry production and has been reported in previous DOI reports as "economic contributions," presents some drawbacks for measuring economic contributions because it does not net out the value of intermediate inputs and thus double-counts some economic activity. *Value added* nets out the cost of intermediate inputs (i.e., goods and services purchased from other industries or imported that are used as inputs to produce a good or service), and is a more appropriate concept when considering Interior's contributions to the nation's gross domestic product (GDP). Of the standard measures available, value added most accurately captures the dollar-value of Interior-managed resources in the U.S. economy. Value added estimates are not available on a comprehensive basis for all Interior resources; this information is provided where such values are readily available.

"Economic impacts" or "economic contributions" as measured by jobs, labor income, value added (contribution to GDP), and output are incomplete measures of "economic value." Economic impacts measure how programs, expenditures, and investments translate to economic growth, employment, and income. Economic value is defined in terms of relative value, and is equal to the amount an individual or society is willing to give up in other goods and services in order to obtain a good, service, or state of the world. More specifically, the economic value of a resource is the amount that society is willing to pay for the resource (not how much they actually pay for the resource).

Figure 1-1 provides a stylized example to illustrate the concept of value added. Trees on a timber lease may ultimately end up as part of a newly constructed house, though there are several supply-chain steps in between. The output approach to economic contributions totals up the sale prices at every step of the chain, in effect double-counting the contributions of intermediate goods. The value added approach focuses on the change in sale price at each step, avoiding this double-counting.





	Standing Trees	Timber	Lumber	Framing	Finished House
Sale Price	$10	$100	$1,000	$10,000	$100,000
Input Price	$0	$10	$100	$1,000	$10,000
Value Added	$10	$90	$900	$9,000	$90,000

Figure 1-1. Value Added: A Stylized Example

The measure of output does not account for external costs and benefits not reflected in market prices.[3] The implication of not including these costs is that statistics on gross sales or output may over- or understate the actual contribution a given activity or sector makes to the economy. *Value added* is a more appropriate concept when considering Interior's contributions to the nation's GDP, though GDP does not fully capture changes in economic welfare.[4] Where possible, this report addresses the economic value of Interior's resources and programs, but the focus of the report remains the economic impacts or contributions of the Department of the Interior.

While this report relied on generally similar methodology to estimate value added and economic contributions, the results are not directly comparable to those of earlier reports due to changes in some of the underlying modeling.

Overview of Outputs Produced and Economic Values

Table 1-1 summarizes the quantities of the key physical and biological outputs produced by Interior in FY 2012. The table also provides information (where such information is readily available) on the unit economic values for each commodity. We report a range of economic values associated with each

[3] In the Department's economic report for FY 2011, Chapter 7 discussed externalities associated with Interior's activities. This chapter is available on the Department's website at http://www.doi.gov/ppa/upload/Chapter-7.pdf

[4] Economic welfare costs also are not fully measured by changes in GDP. GDP fails to capture nonmarket values, such as environmental improvement or environmental damages. These can be important components of total economic welfare. GDP also can sometimes be misleading: for example, cleanup costs from an oil spill would increase GDP, however, this provides little information about the total economic costs incurred by individuals and society overall.

resource, and we report total production for the year. The table does not associate production with individual unit prices, so we do not report a total value for the annual production.

Table 1-1. Interior-Managed Resources: Production Quantities and Values, FY 2008-FY2012

Commodity	Units	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Recreation [c]	*Visits to DoI sites (million)*	n/a	415	439	434	417
	Estimated range of economic values, $ per visit	n/a [b]	n/a [b]	n/a [b]	n/a [b]	$35.98 - $63.32
Crude oil	*Federal production, millions of barrels (mmbbl)*	575	657	736	649	626
	WTI - Average value, $ per bbl (2012-$) [d]	$106.29	$66.30	$83.69	$96.84	$94.05
Natural Gas [e]	*Federal production, trillions of cubic feet (tcf)*	6	6	5	5	4
	Avg wellhead price, $ per mcf (2012-$) [d]	$8.50	$3.93	$4.72	$4.03	$2.66
Coal [f]	*Federal production, millions of tons*	509	488	478	470	460
	Avg price subbituminous coal, $ per short ton, (2012-$)	$11.34	$12.17	$12.71	$13.94	9.02
Hard rock minerals - gold	*Estimated gold production on federal lands , kilograms*	100,190	95,890	99,330	100,620	98,900
	Avg gold price, $/ounce	$874	$974	$1,228	$1,572	$1,700
Forage [g]	*AUMs permitted (millions)*	8.55	8.61	8.24	8.27	8.95
	$ per AUM					$1.35 -$17.00
Timber [j]	*BLM, sawtimber harvested, mbm*	162,902	190,504	183,558	217,890	207,451
	BIA harvested timber, mbm	530,972	426,250	396,532	359,697	333,209
	Average western OR BLM price received, $ per mbf	$178.12	$153.39	$92.57	$92.55	$ 119.57

(Table continues)

Commodity	Units	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Electricity generation [i]						
Hydroelectric	*Net generation, TWh*	40.8	39.5	35.8	48.6	47.5
Geothermal	*MW installed capacity to-date*	0	67.5	30	327	70
Wind [h]	*MW installed capacity*	140	4	12	160	315
Solar [h]	*MW approved capacity*	0	0	2,744	1,975	489
	Average on-peak spot electricity price, $ per MWh	$65–$80.14	$35.66–$38.31	$35.90–$40.21	$29–$37	$22.22–$34.57
Irrigation and M&I water (estimated)	*Acre-feet delivered (estimated)*	Estimated annual deliveries: 23.9 million a-f of irrigation water and 2.8 million a-f of M&I water				26.7
	$ per acre-foot	Values for much of Reclamation-supplied irrigation water are in the range of hundreds of dollars per acre-foot. M&I water is typically valued in the range of one to two thousand dollars per acre-foot. Values depend on the region, end-use, and other circumstances. Some Reclamation-supplied water is delivered for other uses such as FWS refuge water supply or to support instream flows. This water would be valued at its opportunity cost, which depends on alternative uses available.				
Ecosystem services	Ecosystem services are measured in many different metrics; information on annual flows of these services is not readily available. Because most ecosystem services are not bought and sold in markets, prices are not readily available.					

[a] Unit values are FY 2012 market values or estimated economic value, depending on the commodity.
[b] Currently available datasets do not track visitors' activities, which vary depending on the particular activity. Some example values include $20 per day for camping, $49 per day for wildlife viewing, and $173 per day for mountain biking. See Chapter 2 for additional details.
[c] Recreation unit values are the means reported in Loomis (2005), updated to 2012-$ using the CPI-U. Total visits includes visits to BOR sites.
[d] Production is based on ONRR sales and non revenue volumes, by sales year. Crude oil prices are WTI per-barrel spot prices from EIA.gov. The minimum price of $75.40/bbl was recorded on October 5, 2011; the maximum price of $109.39/bbl was recorded on February 27, 2012.
[e] Production is based on ONRR sales and non revenue volumes, by sales year. Natural gas prices are U.S. wellhead price per mcf from EIA.gov. The minimum price of $1.89/mcf was recorded in April 2012; the maximum price of $3.62/mcf was recorded in October 2011.
[f] Coal prices from EIA.gov: http://www.eia.gov/totalenergy/data/annual/pdf/sec7_21.pdf, updated to 2012-$ using the CPI-U.
[g] The low-end value is the federal grazing fee; the high-end value is the 11 Western state average rental price for private forage.
[h] Generation information is not available for these resources.
[i] The low-end value is the Mid-Columbia price; the high-end value is the SP 15 price.
[J] Source: BLM, PLS, Table 3-12, various years and other BLM data. Does not include volumes and values associated with the BLM's stewardship contracting, as well as modification volume and small sales program volume.

Value Added and Economic Contributions

DOI's FY 2012 value added and economic contribution are estimated to be $211 billion and $371 billion, respectively. The value added and economic contributions are estimated to have supported 2.3 million jobs in FY 2012. The value of all commodities and other inputs to production associated with Interior's activities increased by about 7% in nominal terms (5% adjusted for inflation), from $134 billion in FY 2011 to $144 billion in FY 2012. The change in value for individual inputs varied significantly across commodities largely due to commodity price changes and changes in the quantity of inputs produced. Detailed estimates of value added, economic contributions, and employment estimates are presented in Table A1-1. Some highlights for value added and economic contributions include the following:

Recreation: An estimated 417 million visits to DOI lands contributed about $24.7 billion in value added, $45 billion in output, and supported 372,000 jobs.

Renewable energy: Activities related to geothermal, wind, and solar energy contributed an estimated $2.3 billion in output, and supported 11,500 jobs. Hydropower contributed about $1.7 billion in value added, $2.2 in output, and supported 7,000 jobs.

Energy from Fossil Fuels: Activities related to oil, gas, and coal contributed an estimated $131 billion in value added, $230 billion in economic output, and supported 1.2 million jobs.

Concepts: Economic Contributions versus Economic Benefits

The results of an economic contributions analysis should not be equated to 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. Net economic benefits can include measures of market values and non-market values.

Economic contributions analysis estimates the total output, value added, and jobs supported by a 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 to derive monetary estimates of benefits and costs to determine the net economic benefits to society. For a further discussion of these issues, see Economic Contributions vs. Economic Benefits on page 125; and Estimating Economic Value on page 130.

Non-fuel minerals: Activities related to hardrock minerals contributed an estimated $13 billion to value added, $21 billion in output, and supported 111,000 jobs.

Timber: Activities related to timber contributed an estimated $554 million in value added, $1.4 billion in output, and supported 7,000 jobs.

Forage: Activities related to forage and grazing on public and Indian land contributed an estimated $1.6 billion in output, and supported 19,000 jobs.

Water: Activities associated with irrigation contributed an estimated $23.1 billion in value added $43.1 billion in output, and supported 315,000 jobs. Activities associated with municipal and Industrial water contributed about $3.8 billion in value added, $4.3 billion in output, and supported 23,000 jobs.

Grants and payments: Activities related to major grants and payments contributed an estimated $8 billion in value added, $11 billion in output, and supported 89,000 jobs. BIA grants to tribal governments contributed about $0.8 billion in value added, $1.2 billion in output, and supported about 11,000 jobs.

Insular Affairs: Interior's activities related to Insular Affairs contributed about $1.2 billion in value added (equivalent to a share of GDP ranging from 6% for the Northern Mariana Islands to 62% for the Marshall Islands); and supported about 35,000 jobs.

Chapter 2 Recreation

Introduction

The U.S. Department of the Interior (DOI or Interior) manages iconic destinations in the national parks, wildlife refuges, cultural and historic sites, monuments, and other public lands that attract travelers from around the country and the globe. These recreation activities help support employment in tourism-related sectors of the economy through visitor spending. Eco-tourism and outdoor recreation on public lands can also have an impact on nearby economies, particularly in rural areas.

Interior provides opportunities for the public to recreate and enjoy our natural and cultural heritage. These opportunities are valuable, as evidenced by the millions of individuals who visit Interior-managed sites. The trip-related expenditures that these individuals make support communities with income and employment. But these expenditures only represent a lower bound on the public's value for these opportunities.

- Value added:$25B;
- Economic contribution:$45B;
- Employment supported: 372,000.

Background

A recent report by the Outdoor Industry Foundation indicates that participation in outdoor recreation activities in 2011 was the highest since 2007, with over 140 million people enjoying 11.5 billion outings.[5] Participation was up among younger generations, with record participation among teenage girls, and young boys reversing the downward trend since 2006. Kayaking participation grew by 27 percent over 2010, and downhill skiing has grown 59 percent since 2008. Forty-two percent of respondents indicated that the state of the economy influences their participation in outdoor recreation; however, over 50 percent planned to spend at or above previous levels on outdoor recreation activities, clothing and footwear.

The U.S. Forest Service (Cordell 2012) reports that the number of people who participated in outdoor recreation nationwide between 2000 and 2009 grew by 7.5 percent, and the number of activity days grew about 32 percent.[6] Participation in nature-based outdoor recreation increased by 7.1 percent over the period, and nature-based activity days increased by about 40 percent. The strongest growth has been in wildlife viewing and photography. Visitation at recreation and historic sites, and non-motorized boating also showed moderate growth in total activity days. Hunting, fishing, backcountry activities and motorized activities had 2009 participation levels similar to those of 2000, while skiing and snowboarding declined in total days over the period.

[5] The Outdoor Foundation. 2012. Outdoor Recreation Participation Report 2012. http://www.outdoorfoundation.org/research.participation.2012.html

[6] Cordell H. Ken. 2012. Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-150. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station, 167 p. http://www.srs.fs.usda.gov/pubs/40453

Participation in outdoor recreation activities varies across demographic groups. For example, hunting, fishing and backcountry or motorized activities are more popular with rural participants, while non-motorized boating and skiing or snowboarding is more popular with urban participants. Youth may be spending more time outdoors than popularly believed: only 16 percent of those aged 6-19 reported having spent 30 minutes or less outdoors on a typical weekday (11 percent for a weekend), while over 60 percent spent 2 or more hours outdoors (77 percent for a weekend).[7] Over 40 percent of these youth reported spending more time outdoors than a year ago. Typically this time is spent "hanging out or playing outdoors" or participating in activities like biking, jogging, walking and skateboarding, which may result in declining participation rates for the activities tracked by the Outdoor Foundation surveys and the National Fishing, Hunting, and Wildlife-Associated Recreation survey.

America's Great Outdoors

President Obama's America's Great Outdoors Initiative (AGO) focuses on supporting healthy outdoor spaces and making them more accessible to Americans. A number of efforts under the AGO initiative have bolstered outdoor recreation, conservation, and restoration of natural resources on public lands, as well as on working farms, ranches, and forests. One part of this initiative is the 2012 redesign of Recreation.gov website, a joint initiative among federal agency partners, including four Interior Bureaus. The seven million visitors who use the web site every year will be able to make reservations, see ready-made itineraries for destination cities, and search for activities on an interactive map. This and other AGO efforts can help promote visitation to our Nation's public lands, and support local economic growth and employment through visitor spending.

Outputs

Public lands continue to be highly important for recreation opportunities. Visitation at units of the National Park Service and Bureau of Land Management was relatively stable from 1996-2012, while visitation to Fish and Wildlife Service units showed growth in the late 1990s, and remained relatively stable since 2000 (Table 2-1). Public lands are important for the participation in a number of outdoor recreation activities across the country, especially in the Western states. For example, 82 percent of primitive camping and 81 percent of developed camping occurred on public lands in the Western States, while 69 percent of primitive camping and 68 percent of developed camping took place on public lands in the Eastern States.[8] In 2012, an estimated 417 million visits were made by American and international travelers to Interior-managed lands. This included:

- 283 million visits at units of the National Park Service;[9]
- 47 million visits at units of the Fish and Wildlife Service;

[7] Cordell, H. Ken, Carter J. Betz, and Gary T. Green. 2009. National Kids Survey, Part I: How Much Time Do Kids Spend Outdoors? http://warnell.forestry.uga.edu/nrrt/nsre/IRISRec/IRISRec9rpt.pdf

[8] Cordell, H. Ken. 2012. Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-150. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station, 167 p. http://www.srs.fs.usda.gov/pubs/40453

[9] NPS visitation data includes visitation for units in U.S. territories; these areas are not included in the economic contribution estimates.

- 59 million visits at units of the Bureau of Land Management; and
- 28 million visits at units of the Bureau of Reclamation.

Table 2-1. Visitation to NPS, FWS, and BLM Sites, 1996-2012

Year	NPS	FWS	BLM
		(million visits)	
1996	266	30	57
1997	275	30	61
1998	287	32	61
1999	287	35	55
2000	286	37	54
2001	280	39	52
2002	277	38	53
2003	266	40	53
2004	277	40	54
2005	274	38	56
2006	273	38	55
2007	276	40	58
2008	275	41	57
2009	273	41	51
2010	285	45	59
2011	281	45	58
2012	283	47	59

Source: 1996-2009 from Cordell (2012). FWS and BLM 2010-2012 from DOI's Economic Contributions (2011, 2012, 2013). NPS 2010-2012 from NPS Visitor Use Statistics.

Economic Contributions and Economic Values

Recreation on Interior lands can contribute to the surrounding regional economies through visitor expenditures and the indirect and induced economic effects that result. Visits to Interior lands in FY 2012 supported about $45 billion in economic activity, and about 372,000 jobs. Value added provided by visitors to Interior sites is estimated to be $24.7 billion. Table 2-2 provides a summary. In 2012, recreation and entertainment represented 10 percent of all U.S. tourism goods and services direct output; the DOI direct recreation contribution represented about 2.2 percent of all tourism direct output.[10]

[10]Bureau of Economic Analysis (BEA) Travel and Tourism Satellite Accounts: http://www.bea.gov/newsreleases/industry/tourism/2013/pdf/tour412.pdf.

Table 2-2. Value Added, Economic Contributions, and Employment Supported - Recreation

Bureau	Estimated Value Added	Estimated Economic Output	Estimated Employment Supported
	($ billions)		(number)
NPS[11]	16.5	30.1	252,000
FWS	2.5	4.5	37,000
BLM	4.0	7.0	58,000
Reclamation	1.8	3.2	26,000
Total	24.7	44.8	372,000

A recent survey by the U.S. Fish and Wildlife Service shows the magnitude of spending by outdoor sportspersons on public and private lands across the United States. Expenditures by the 90.1 million hunters, anglers and wildlife-recreationists were $145 billion in 2011. This equates to about 1 percent of gross domestic product.[12] Figure 2-1 below shows participation in fishing, hunting, and wildlife-related recreation over 1991-2011. Participation has increased from about 77 million in 1996 to about 90 million in 2011, a 17 percent increase. Expenditures (in constant dollars) have increased by about 13 percent over the same period.

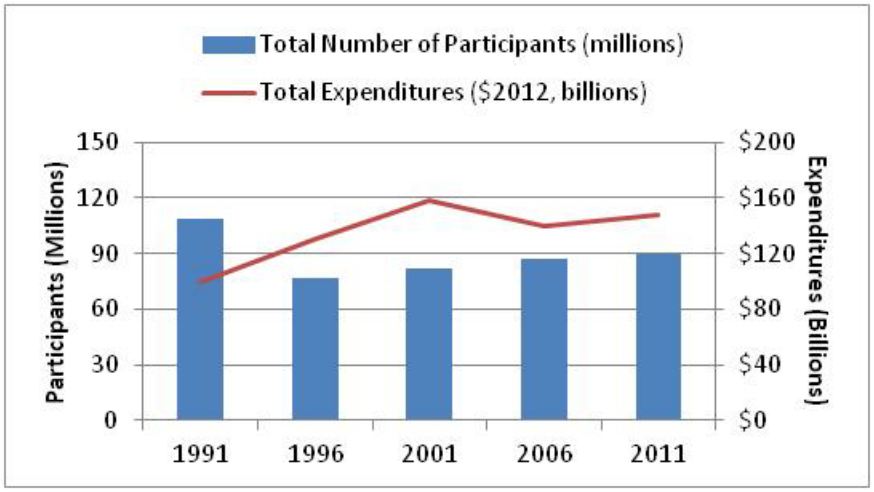


Figure 2-1. Participation and Expenditures in Hunting, Fishing and Wildlife-Associated Recreation[13]

In 2011, an estimated $7.1 billion was spent for trip-related recreation equipment on DOI land. Sixty-six percent of total trip-related equipment expenditures were for wildlife watching items, 17 percent for

[11] NPS estimates of value added, economic contributions, and employment are based on 2011 visitation data, and do not include visitation to NPS units in U.S. territories.
[12] USFWS, 2012. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation
[13] Source: National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

hunting items, and 16 percent for fishing items. Expenditures on trip-related equipment were $21 per day of recreation on DOI land.[14]

While expenditures are a useful indicator of the importance of outdoor recreation and visitation to cultural and historic sites, they do not measure the net economic value to either the individual participant, or when aggregated, to society. Net willingness-to-pay, or "consumer surplus" is an accepted measure of the economic value of recreation to individuals and society. Net economic value is measured as participant's willingness to pay for recreation over and above what they actually spend to participate. Over the past 40 years, many economic studies have provided estimates of consumer surplus values associated with recreation activities.

Increasing International Travel to the United States

International spending on U.S. travel and tourism-related goods and services set an all-time record of $168 billion in 2012, an 10 percent increase from 2011, and supported an additional 103,000 jobs for a total of 7.6 million industry jobs. President Obama signed an executive order in January 2012 to significantly increase travel and tourism in and to the United States, with a goal of welcoming 100 million international visitors annually by the end of 2021. As of the end of the 2012, total foreign visitation to the U.S. for the year was 61.1 million (source: http://tinet.ita.doc.gov/view/m-2012-I-001/index.html).

Since recreation and other environmental amenities are not traded in markets, the tools used to measure their value are referred to as non-market valuation methods. These methods use data from related markets (revealed preference methods) or information from surveys of the public (stated preference methods) to estimate values for environmental goods and services. Some revealed preference methods include travel cost models and hedonic pricing methods. Stated preference methods include contingent valuation and conjoint analysis (survey techniques that attempt to determine the value that people assign to a specific amenity or group of amenities). Benefit transfer techniques that employ specific and accepted methods are also often used to apply estimates from previous studies to new situations when additional primary research is not feasible.

Many studies have been conducted to estimate these values for specific recreation sites and recreation uses using a variety of economic analyses. Several reviews of the recreation economic valuation literature have been completed over the years including an on-going effort at Oregon State University. Figure 2-2 shows mean estimated "use" values for different recreation activities for studies completed in the United States and Canada between 1958 and 2006 (all values have been converted to 2010 US$).

The Harvard Kennedy School of Government and Colorado State University have teamed to conduct the first-ever, comprehensive economic valuation study of the National Park Service. This study will estimate total economic values for the entire 398-unit National Park System and the more than 30 NPS programs

[14] USFWS, 2012. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. On all lands nation-wide, 2011 total wildlife-related recreation expenditures were estimated to be $144.7 billion. Thirty-eight percent was attributed to wildlife watching, 29 for fishing, 23 for hunting and 10 percent unspecified.

that operate outside of the national parks, such as the Rivers, Trails, and Conservation Assistance Program. In addition to estimating total economic values for these parks and programs, this study will also conduct a number of case studies of parks and programs to illustrate these values. The design of the study is currently underway, and it is expected to be completed in 2015.

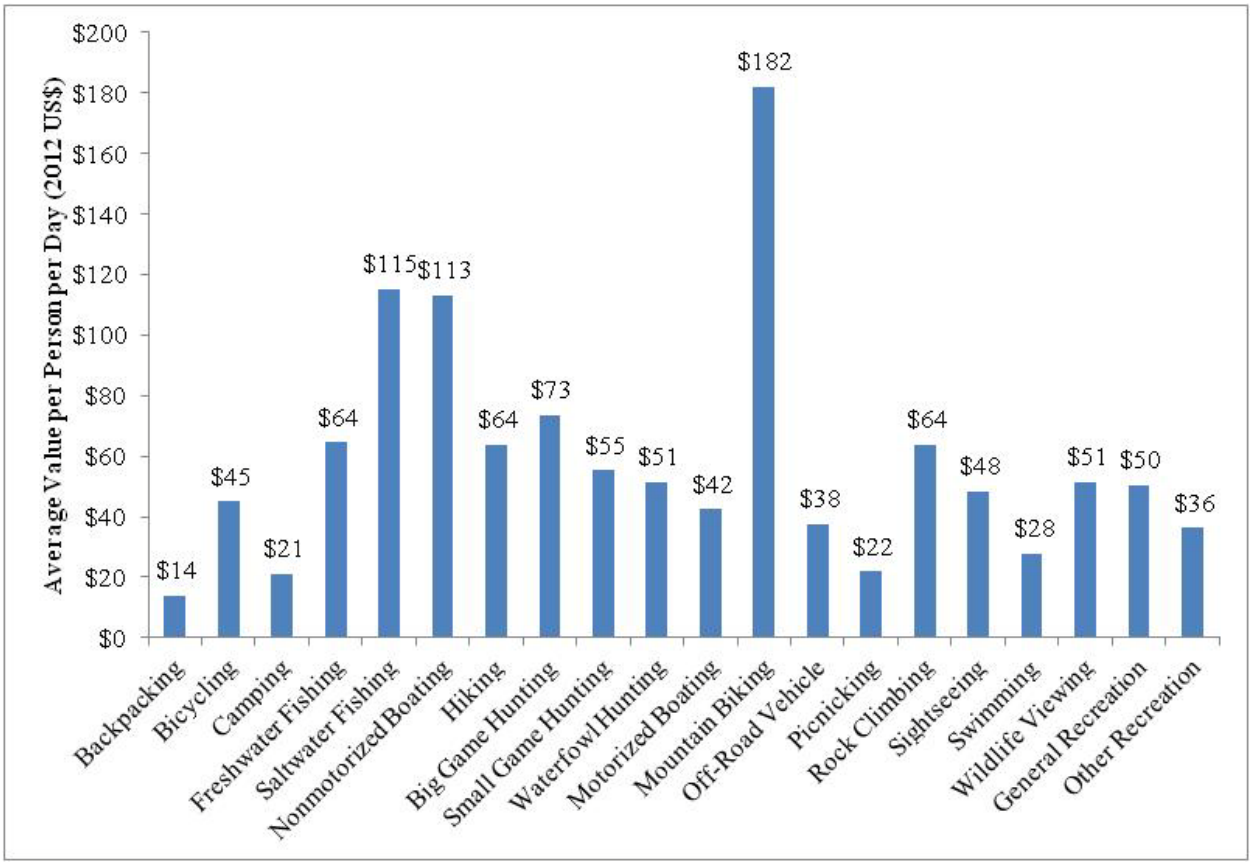


Figure 2-2. Average per-Day Net Economic Value for Outdoor Recreation Uses (2012-$)[15]

[15] Source: Oregon State University Recreation Use Values Database (Available at: http://recvaluation.forestry.oregonstate.edu/)

Chapter 3 Conservation

Introduction

The Department of the Interior (DOI or Interior) supports conservation efforts across the United States through activities on public lands, scientific research, and grant programs, among others. Conservation of landscapes and ecosystems help support numerous activities, such as tourism, outdoor recreation, cultural observances, and working landscapes that all make significant contributions to the well-being of the nation and local communities. Interior's efforts help support species and habitat protection, the maintenance of working landscapes, and the provision of ecosystem services such as clean water, timber, fisheries habitat, and carbon sequestration.

The value added, economic contributions, and employment supported by DOI's conservation related activities are difficult to isolate because conservation could be a component of recreation, ecosystem restoration, water management, and even some mineral development activities. Many of the benefits of nature to households, communities, and economies are not defined with a set of consistent metrics nor are they bought and sold in markets. This creates challenges in the valuation of these goods and services.

Outputs

Figure 3-1 shows the location of conservation lands managed by the Bureau of Land Management (including BLM lands in the National Landscape Conservation System), the National Park Service (including all NPS lands), and the U.S. Fish and Wildlife Service (including National Wildlife Refuges and associated Waterfowl Production Areas) in the continental United States.

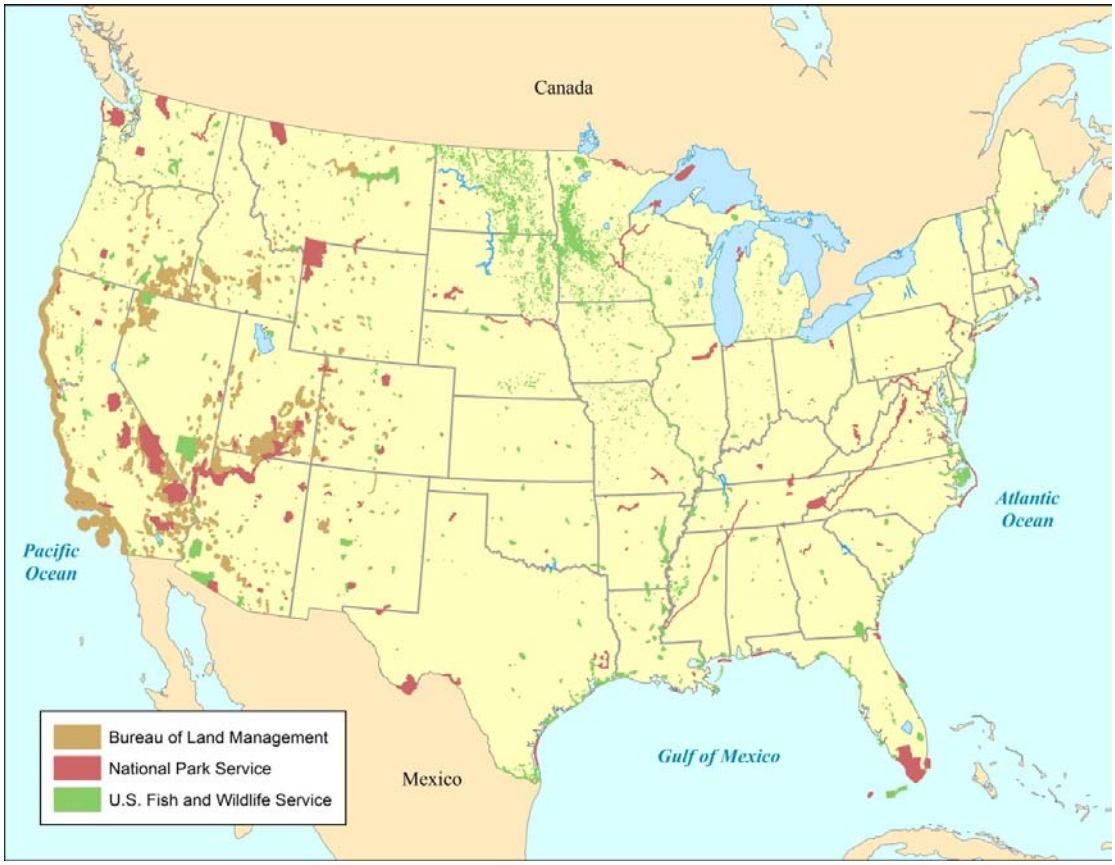


Figure 3-1. BLM, NPS and USFWS Conservation Lands in the continental United States

One of the primary ways federal land management agencies promote conservation efforts is through land and easement acquisition. The Land and Water Conservation Fund (LWCF) is the principal source of funding for federal public land and easement acquisition. The LWCF Act of 1965 was enacted to help preserve, develop, and assure access to outdoor recreation resources. Figure 3-2 shows Interior LWCF appropriations for land acquisition from FY2008 through FY2012 (all values have been converted to 2012 US$, totals do not include Forest Service funding or LWCF funds not used for land acquisition).

The Migratory Bird Conservation Fund (MBCF) provides funding for FWS land acquisition programs to purchase waterfowl habitat in major migratory bird conservation areas and Waterfowl Protection Areas (WPAs). One of the major sources of funding for the MBCF is the sale of Federal Duck Stamps, which are required to hunt migratory waterfowl and can be used for admission to NWRs. In FY 2011 (the most recent year currently available), $19.4 million of MBCF funding was disbursed for the acquisition of land and interests in land totaling 29,683 acres at major migratory bird conservation areas, and $33.8 million for land and interests in land totaling 51,511 acres at WPAs.

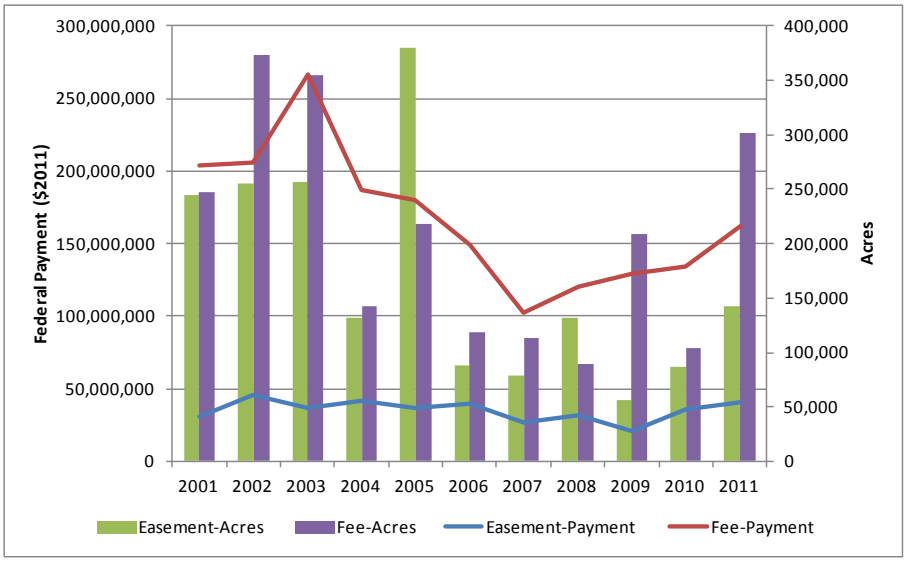
Source: DOI data.

Figure 3-2. Department of the Interior LWCF Land Acquisition Appropriations, FY 2008–FY 2012

Interior acquires land through a combination of fee purchase and easements. Figure 3-3 shows the trend (from 2001 to 2011) of payments and acres acquired for both fee simple purchases and easements for NPS, BLM and USFWS. Although variation from year to year can depend on a number of factors including land prices and the location of individual purchases, total payments for easement purchases have been significantly less than fee payments over the period.

In addition to land acquisition, DOI bureaus provide funding for conservation efforts through a number of grant programs. For example, the USFWS supports conservation though Coastal Wetlands Conservation grants, Cooperative Endangered Species Funds, the Multi-State Conservation Grant Program, and a number of other conservation grant programs. The NPS also provides grant funding for several natural and historical conservation programs.

DOI has made funding available for adaptive management efforts including Landscape Conservation Cooperatives. Other DOI investments that support conservation efforts include science research, fish hatcheries, and conservation management activities. One recent effort is on-going climate research led by USGS which addresses carbon sequestration and other aspects of climate science. DOI conservation efforts also include activities involving ocean issues and invasive species. For example, Interior played an important role in the development of the recently released National Ocean Policy Implementation Plan, as a key member of the National Ocean Council. The National Invasive Species Council (NISC) works to ensure that Federal programs and activities to prevent and control invasive species are coordinated, effective and efficient.



Source: DOI data.

Figure 3-3. Land Acquisition Payments and Acreage, 2001-2011

Value Added, Economic Contributions and Economic Values

The value added, economic contributions, and employment supported by DOI's conservation related activities are difficult to isolate because conservation could be a component of recreation, ecosystem restoration, water management, and even some mineral development activities.

One discrete aspect of DOI's conservation activities is related to land acquisition. In FY 2012 DOI's land management bureaus were appropriated $146 million for land acquisition. These funds are estimated to be associated with $65 million in value added, $128 million in economic output, and to support 900 jobs. DOI also administers grant and payment programs that support conservation. Their economic contributions are discussed in Chapter 11.

Investments in conservation through land acquisitions and grant programs provide benefits to society in the form of species and habitat protection, maintenance of working landscapes, and the provision of ecosystem services (such as clean water, timber, fisheries habitat, and carbon sequestration). The measurement of benefits from conservation investments can provide important information to policymakers for future decisions. Economic techniques allow the benefits and costs of conservation investments to be represented in monetary terms, enabling comparison across locations or projects in a common metric. Absent the ability to quantify benefits in monetary terms, physical measures of benefits (e.g., number of species conserved) can be substituted, where either measure of benefit can be used to calculate a return on investment. Such calculations can provide valuable information to evaluate, target and prioritize land acquisition decisions or other conservation activities.

Some studies have estimated values for ecosystem services at specific locations. Interior has been involved in a number of recent studies that quantify ecosystem services and provide information for decision makers. For example, in the context of determining whether to support removing four dams on the Klamath River, DOI estimated nonuse values to capture the benefits that would accrue to society

from fish habitat and river ecosystem improvements in the Klamath River Basin.[16] The BLM and USGS recently completed a pilot project on the San Pedro River watershed that evaluated alternative methods and tools that quantify and value ecosystem services, and assessed the tools' readiness for use in BLM's decision making process.[17] USGS and Colorado State University have developed a public domain tool called Social Values for Ecosystem Services (SolVES) that uses data from public attitude and preference surveys to assess, map, and quantify social values for ecosystem services.[18]

Numerous factors can affect biological and ecological functions such as climate change, pollution, and changing land uses. These factors in turn can affect the conservation values and the net economic value of conserved lands. Additional research into the value of ecosystem services provided by conservation lands could provide additional information useful to policymakers when considering future public land acquisitions.

[16] Benefit Cost and Regional Economic Development Technical Report For the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. U.S. Department of the Interior Bureau of Reclamation, July 2012.

[17] Bagstad, K.J., Semmens, Darius, Winthrop, Rob, Jaworski, Delilah, and Larson, Joel, 2012, Ecosystem services valuation to support decision-making on public lands—A case study of the San Pedro River watershed, Arizona: U.S. Geological Survey Scientific Investigations Report 2012–5251, 93 p.

[18] Sherrouse, B.C., and Semmens, D.J., 2010, Social Values for Ecosystem Services (SolVES)—Using GIS to include social values information in ecosystem services assessments: U.S. Geological Survey Fact Sheet 2010–3118, 2 p.

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Chapter 4 Energy from Fossil Fuels

Introduction

As manager of one-fifth of the nation's landmass and 1.7 billion acres offshore, the U.S. Department of the Interior (DOI or Interior) has the resources to help the country produce more conventional energy at home.

Fossil fuels continue to be a major component of our Nation's energy portfolio. The United States spends hundreds of billions of dollars each year to buy oil to power our country.[19] Dependence on foreign oil is a concern for our national security, our environment and our economy. Even as the Nation responded to the Deepwater Horizon oil spill in the Gulf of Mexico, total U.S. crude oil production was higher in 2010 than in any year since 2003. U.S. natural gas production is also increasing; withdrawals totaled 29.7 tcf (trillion cubic feet) in FY 2012, surpassing FY 2011 production by 6 percent. These are the highest levels of U.S. production since FY 2001, when withdrawals totaled 24.5 tcf. Overall, oil imports have fallen by 9 percent since 2008, and net imports as a share of total consumption have declined from approximately 60 percent over 2004 - 2008 to approximately 41 percent in 2012.

Public lands are a source of fossil fuel energy resources, and the public receives a return on assets developed under Interior management. The values for these commodities are reflected by their prices in well developed markets, though market prices do not reflect all of the costs and benefits associated with resource exploration, development, production, and use.

- Value added: $131 B;
- Economic contribution: $230 B;
- Employment supported: 1.2 M.

Background – Oil, Gas, and Coal Leasing

Oil and Gas Leasing

Federal onshore oil and gas resources are managed by the Bureau of Land Management (BLM), and offshore federal oil and gas resources are managed by the Bureau of Ocean Energy Management (BOEM) and regulated by the Bureau of Safety and Environmental Enforcement (BSEE). Leasing on Native American lands is approved by the Bureau of Indian Affairs (BIA).

Onshore and offshore leases are awarded to oil and gas companies using competitive bonus-bid auctions. Winning bidders pay the bonus bid, a per-acre rent prior to first production, and royalties once production begins. There are some differences between the onshore and offshore leasing processes:

- Onshore, parcels are nominated for leasing by interested parties. Parcels identified by BLM as available for leasing are then sold at a competitive auction using an oral bidding process. For two years after a parcel is not sold at a competitive auction, the BLM offers it "over-the-counter" on a non-competitive basis, in accordance with statute.

[19] See EIA's Annual Energy Review, http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0520.

- Offshore, BOEM identifies available acres using public comment and publishes a five-year leasing program. Leases are then sold using a sealed bid auction where the highest qualified bidder is awarded the lease (following a thorough fair market value evaluation). The 2012-2017 oil and gas leasing program continues to make available more than 75 percent of undiscovered technically recoverable oil and gas estimated to be on the OCS.[20]
- Parcels on tribal land are nominated for leasing by a mineral owner, a mineral development company or a tribe by passage of a resolution. Leases are then awarded via competitive auction or negotiation between Indian mineral owner and an interested party. The BIA approves the lease and BLM issues the drilling permit.[21]

Oil Spill Response Planning

During FY 2012, BSEE approved the Oil Spill Response Plan (OSRP) for Shell Gulf of Mexico, Inc.'s operations in the Chukchi and Beaufort Seas. Also in FY 2012, Interior coordinated exercises and emergency response planning by U.S. agencies in the Arctic; expanded scientific work, information collection and data sharing among agencies, industry, and research institutions to inform Arctic planning; and undertook long-term, landscape-scale planning for

Oil and gas royalty rates vary, depending on whether the production is off- or onshore. The onshore rate is typically 12.5%; the offshore rate can range from 12.5% to 18.75%. Some Oil and gas revenues (bonus bids, annual rents, and royalties) are shared with states.

Coal Leasing

BLM has responsibility for coal leasing on approximately 570 million acres where the coal mineral estate is owned by the Federal Government. The surface estate of these lands could be controlled by BLM, the United States Forest Service, private land owners, state land owners, or other Federal agencies. Public lands are available for coal leasing only after the lands have been evaluated through the BLM's multiple-use planning process. In areas where development of coal resources may conflict with the protection and management of other resources or public land uses, the BLM may identify mitigating measures. Coal on federal land is primarily leased competitively in the following manner[22]:

(1) By regional leasing, where the BLM selects tracts within a region for competitive sale,[23]or
(2) By application, where the public nominates a particular tract of coal for competitive sale.

[20] For additional details see: http://www.boem.gov/5-year/2012-2017/.
[21] For additional details see http://www.bia.gov/cs/groups/xraca/documents/text/idc-020740.pdf.
[22] Coal leases may be issued non-competitively through a preference right lease application and/or a modification to an existing lease.
[23] There have been no regional lease sales in recent history.

Prior to a sale of a coal lease, the BLM calculates a "fair market value" of the coal, and accepts sealed bids, which are publicly announced during the sale. The lease is awarded for the highest eligible bid that meets or exceeds the estimated fair market value, and the winner pays, at a minimum, the first year's annual rental payment and one-fifth of the amount bid, the first of five installments guaranteed by bond.

Coal royalties are shared on a 50-50 basis with the state where the coal was mined. The shared revenues include bonus bids, annual rental revenues of $3 per acre, and royalties of 12.5% of the value of surface-mined coal (8% for subsurface).

Leasing Statistics, Outputs and Price Trends

Leasing and Permitting Statistics

Offshore Oil and Gas: In FY 2012, BOEM held two lease sales in the Gulf of Mexico. Lease Sale 218 was completed on December 14, 2011. This sale resulted in over 1 million acres being leased in the Western Gulf of Mexico Planning Area and about $325 million in bonus bids. Lease Sale 216/222 was held on June 20, 2012 offering over 39 million acres in the Central Gulf of Mexico Planning Area. This sale resulted in 2.4 million acres being leased and about $1.7 billion in bonus bids. Funds from the accepted high bids will be distributed to the general fund of the U. S. Treasury, shared with the affected states, and set aside for special uses that benefit all 50 states.

In FY 2012, BSEE approved 476 permits for deepwater drilling and 443 permits for shallow water drilling on the OCS.

Onshore Oil and Gas: Oil and gas companies nominated 5.9 million acres of public minerals for leasing in 2012, up from 4.5 million acres the year before. The BLM held 30 onshore oil and gas lease sales in 2012 offering 2,064 parcels of land covering nearly 4.7 million acres. Over three-quarters of those parcels were sold: 1,554 parcels covering nearly 1.4 million acres, and generating about $261 million in bonus and rental revenue for American taxpayers. This was a 9 percent increase in lease sale revenue over 2011, following a strong year in which leasing reform helped to lower protests and increase revenue from onshore oil and gas lease sales on public lands.

In FY 2012, the BLM processed 5,861 applications for permits to drill (APDs) on Federal and Indian lands. In 2013 and 2014, BLM expects to process more than 5,000 APDs annually.

Coal: In FY 2012 the BLM held 9 coal lease sales, of which 6 were successful, covering 15,390 acres, with a total accepted bonus bid of $1.55 billion. This was a substantial increase over FY 2011, when BLM sold a total of 8 Federal coal leases (across all categories) covering 6,463 acres for $347 million in bonus bids.

Crude Oil – Output and Prices

Figure 4-1 presents on and offshore federal oil royalty bearing production and prices from October 2006 to July 2012. Interior currently manages about 38 million acres of the Outer Continental Shelf (OCS) under active lease (of which 6.5 million acres are producing); that management includes safety and environmental enforcement. Total oil sales volumes from Federal and Indian lands, including the Federal OCS, increased from 575 million bbl in FY 2008 to 736 million bbl in FY 2010, and then decreased to 626

million bbl in FY 2012.[24] Production from Federal and Indian lands makes up approximately 27 percent of total domestic production. In FY2012, BOEM and BSEE oversaw the federal offshore production of almost 474 million barrels of oil, which accounts for approximately 76 percent of crude oil production from Federal and Indian lands. The remaining 24 percent is from an onshore sales volume of 152 million barrels on Federal and Indian lands.

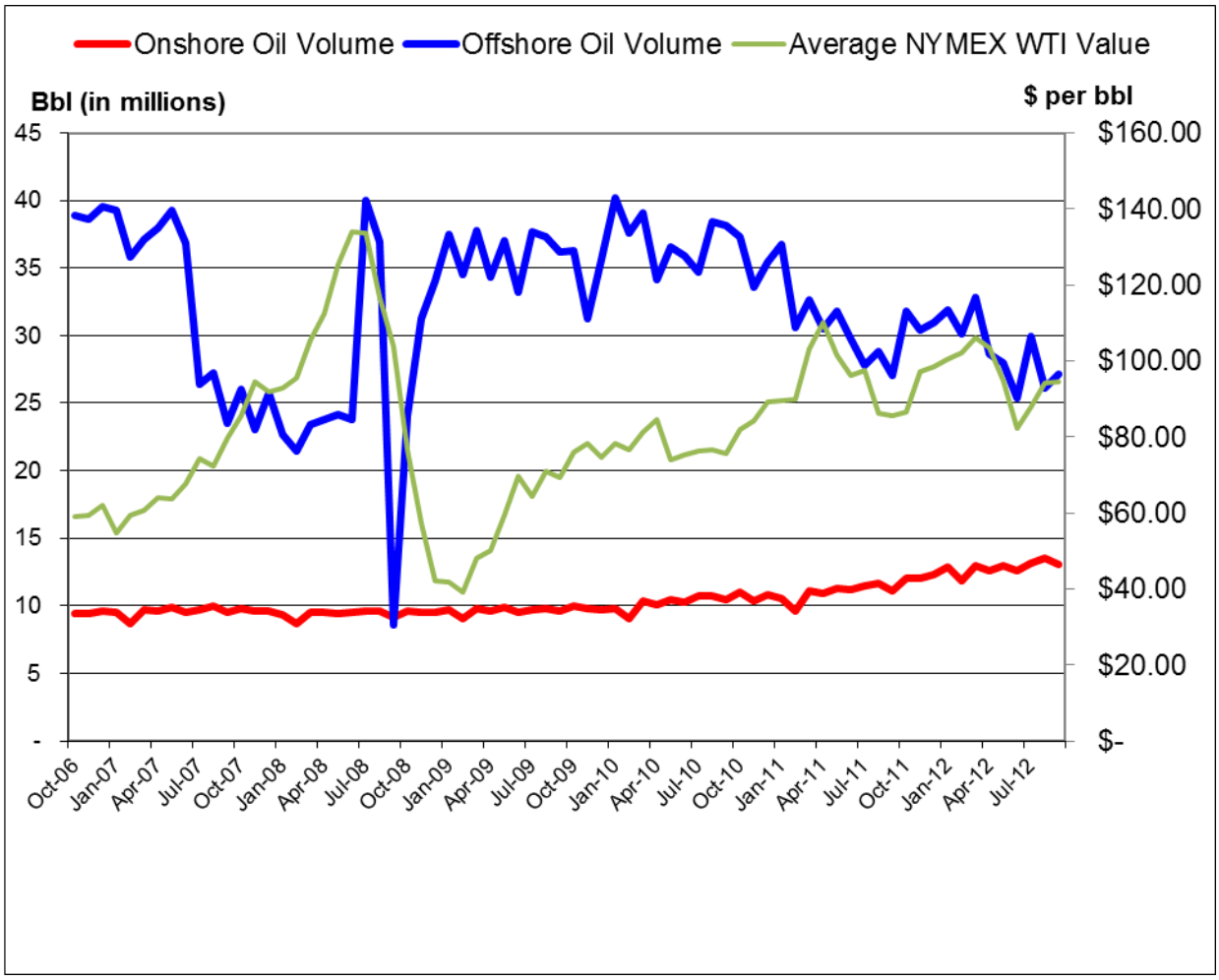

Figure 4-1. Federal Royalty-Bearing Oil Production and Price, FY 2007-FY2012

Source: ONRR data; EIA data.

[24] The Office of Natural Resources Revenue (ONRR) collects data on sales volumes for purposes of assessing royalty payments. The sales data are a proxy for marketed production volumes. Total sales volumes include royalty and non royalty bearing volumes.

As shown in Table 4-1, FY 2012 average prices for crude oil and petroleum products were five to ten percent above 2011 averages.

Table 4-1. Oil and Gas Product Prices (2002-2012)

FY	Crude Oil ($/bbl)	Conventional Gasoline ($/gal)	No 2 Heating Oil ($/gal)	Residential Natural Gas ($/mcf)
2002	23.12	0.66	0.63	8.50
2003	28.22	0.85	0.83	10.16
2004	34.54	1.08	0.98	11.28
2005	51.24	1.49	1.53	12.68
2006	64.45	1.84	1.83	14.93
2007	65.25	1.86	1.83	14.03
2008	105.32	2.71	3.02	15.58
2009	56.50	1.48	1.61	13.61
2010	76.55	1.98	2.03	12.86
2011	105.53	2.64	2.79	12.64
2012	111.48	2.81	3.00	12.23

Source: EIA data.

Natural Gas – Output and Prices

Total U.S. natural gas production has set new records every year since 2007. In FY 2012 the Nation produced an estimated 29 trillion cubic feet, a 14% increase over FY 2008, largely due to shale gas resources. Figure 4-2 shows Federal on- and offshore royalty bearing gas production and prices over 2006-2012. EIA and ONRR data indicate that Federal sales account for 19 percent of total domestic production for FY 2012. Natural gas sales volumes from Federal and Indian lands have decreased each year since FY 2003, when Federal sales accounted for a record 34 percent of U.S. production (EIA 2012; ONRR 2012). This trend reflects declining gas production from the Federal OCS, as development has moved from the gas-prone shelf to the richer oil-prone deep waters of the Gulf of Mexico. As federal production offshore has declined, however, the production from onshore Federal lands has been generally growing since 2003. In FY 2003 production of processed and unprocessed gas was about 1.9 trillion cubic feet (tcf) onshore and 4.2 tcf offshore. By FY 2012, onshore production had grown to 2.4 tcf, while offshore production was only 1.3 tcf. Over the past several years natural gas prices have been in the range of $3-4 per mmBtu.

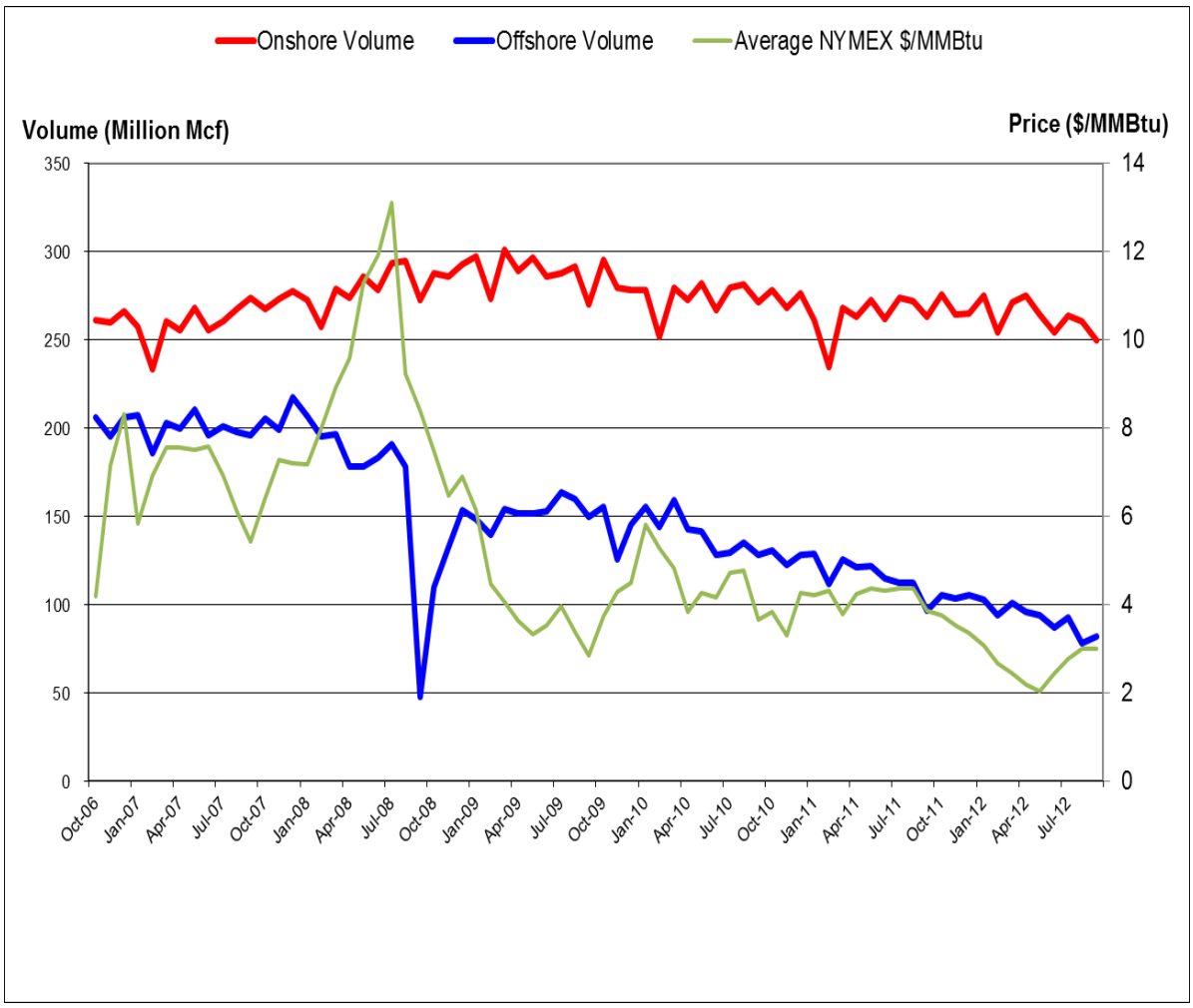

Figure 4-2. Federal Natural Gas Royalty-Bearing Production and Price, 2006-2012

Source: ONRR data; EIA data.

Over this same period, Federal gas production (onshore and offshore combined) has accounted for a falling proportion of total U.S. marketed production. Policies that pertain directly to leasing and production activities on Federal and Indian lands are only one among the many factors that are reflected in the production data. The rapid increase in natural gas production from shale resources, found largely outside the Federal lands, over the last 5 years has significantly reduced natural gas prices and the relative attractiveness of non-shale natural gas resources, including those on Federal and Indian lands.

As shown in Figure 4-3, monthly averages of the 2012 natural gas price cycle were at or below their 2011 levels.

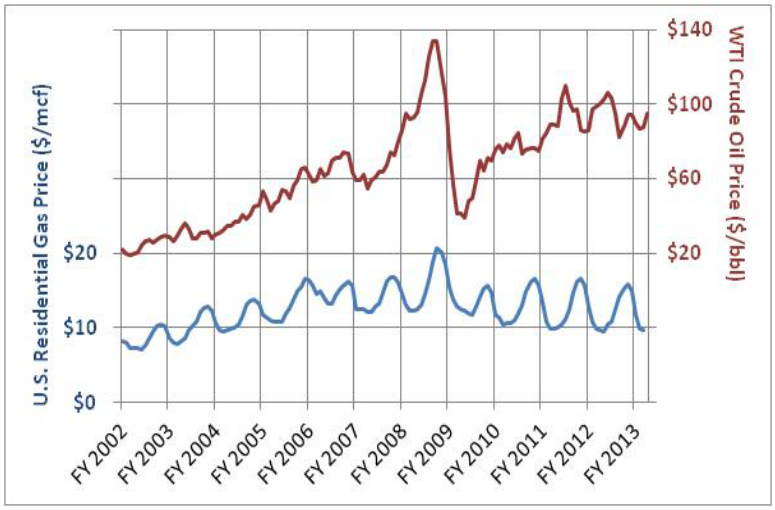

Figure 4-3. U.S. Residential Natural Gas Price, FY 2002 – FY 2012

Source: EIA data.

Coal – Output and Prices

Figure 4-4 shows federal coal production and prices from October 2006-September 2011. NYMEX coal futures for coal from the Powder River Basin averaged $8.78 per ton in 2012, with a minimum of $6.75 and max of $12.24 per ton. Coal production from Federal and Indian lands has remained steady over the past 4 years decreasing slightly from 508 million tons in FY 2008 to 461 million tons in FY 2012. Despite a decrease in U.S. coal production from FY 2011 to FY 2012, the federal sales share of U.S. coal production remained unchanged at 43%. In their latest forecasts, EIA predicts that Interior's share of coal production will decrease through 2020 but increase thereafter (EIA 2013 AEO). Since 2006 coal prices (in nominal terms) for federal coal produced in Wyoming and Montana have been in the range of $10-13 per ton; prices for coal produced in other states has ranged from $30-40 per ton. Prices for coal declined at the beginning of 2012 and remained below the average levels of 2011.

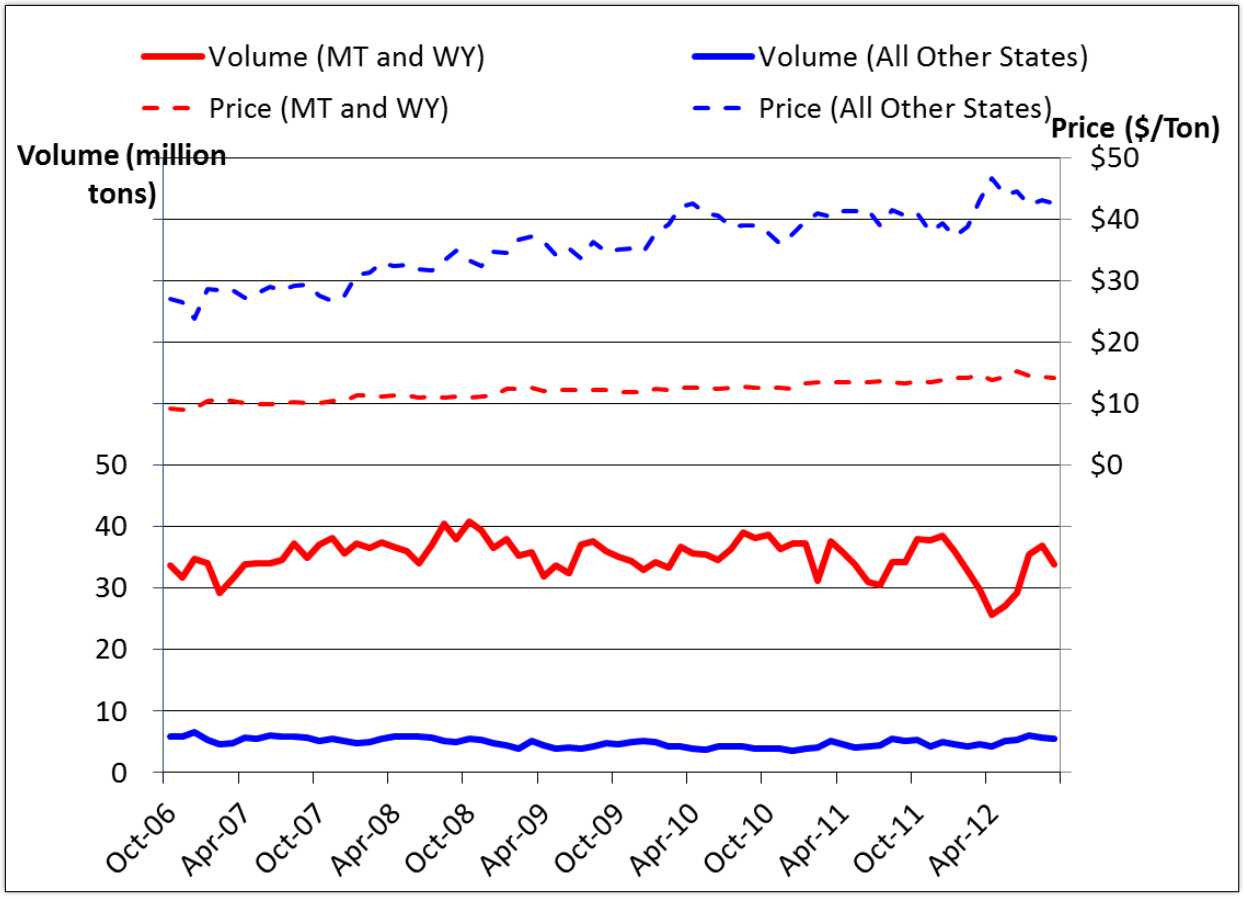

Figure 4-4. Federal Coal Volumes and Prices

Source: ONRR data; EIA data.

Royalties

In FY 2012, Interior collected a total of $11.6 billion in mineral receipts, including royalties, rents and bonuses. $11.4 billion[25] was related to oil, gas and coal production on public lands, tribal lands, and Federal offshore areas – an increase of $0.8 billion over the previous year. These receipts are disbursed among Federal, State, and tribal governments.

Economic Contributions

Economic contributions arise in the following manner. Leases on federal lands are sold. These sales generate bonus bids and rents prior to exploration, development, and production. These revenues are transferred from companies to ONRR, and then to Treasury, States, Tribes. Companies pursue exploration and development and in the course of doing so employ labor and capital. Assuming minerals are discovered in economic quantities, the companies then produce salable minerals. Production involves hiring labor and capital; royalty revenues are subsequently transferred from producers to

[25] The remaining $0.2 billion is made up of receipts on various resources leased on Federal lands including but not limited to copper, lead and sand/gravel.

ONRR, and then to Treasury, States, and Tribes. Reclamation activities are undertaken concurrently with production or when production ceases. These activities also require labor and capital, and may enhance various nonmarket goods and services.

This report has developed national and state-level estimates of value added, economic contributions, and employment estimates for on- and offshore federal and Indian oil, gas and coal production. The state-level estimates are presented in Appendix 2. State-by-State Information; the national-level estimates for FY 2012 are as follows:

- Offshore oil and gas production contributed an estimated $122 billion in total output, over $59 billion in value added (approximately 0.4% of total U.S. GDP) and supported 732,000 domestic jobs (approximately 0.6% of all U.S. employment).
- Onshore oil and gas production resulted in an estimated total output of about $76.9 billion in total output, about $49.2 billion in value added, and supported approximately 360,000 jobs (approximately 0.3% of all U.S. employment).
- Coal production resulted in total output of about $16.9 billion, about $10.3 billion in value added, and supported approximately 80,000 jobs (approximately 0.06% of all U.S. employment).

Economic Values

The oil, gas, and coal, produced from Interior lands is, in general, sold in competitive markets and the market value of these resources can be reasonably assumed to reflect their economic value and their opportunity costs. However, where external costs are associated with the development, production, and use of these resources, market prices do not fully reflect opportunity costs. For example, in considering whether an area could be leased for oil and gas development the market value of the extractable oil and gas can be reported in monetary terms. However, external factors to this decision, such as the effects of exploration, development and extraction on air and water quality, recreation opportunities, wildlife habitat, or energy security cannot be easily accounted for in dollar terms. Various regulations and other requirements including bonds, mitigation and reclamation help to minimize adverse environmental impacts and internalize some of the external costs.

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Chapter 5 Renewable Energy

Introduction

In FY 2012, 12.2% of the nation's electric power was generated via renewable resources.[26] The Administration's energy strategy encourages increased conventional energy production, and has also opened a new frontier for solar, wind, and geothermal energy production on public lands and waters. Development of utility-scale renewable energy projects on federal land occurs primarily on lands managed by BLM and, to a lesser extent, on tribal lands and areas managed by the Forest Service.[27] Hydroelectric power plants operated by the Bureau of Reclamation (Reclamation) continue to provide low cost sources of renewable energy. Reclamation is the second largest producer of hydroelectric power in the United States, which ranks fourth in the world for hydroelectric power production. Reclamation maintains 58 hydroelectric plants accounting for 23 percent of the hydroelectric generating capacity in the Western United States.

In aggregate, generating electricity by renewable energy reduces the amount of electricity supplied by fossil fuel plants, along with the associated emissions. Market values of power typically do not consider these external costs associated with fossil fuel generated electricity. Renewable energy activities were estimated to:

- contribute $4.4 billion in output; and
- support 18,000 jobs.

Background

Wind and solar leases are treated as "rights-of-way" and are issued on a first-come-first-serve basis with the exception of offshore wind leases which are generally offered competitively. Geothermal leases are allocated via competitive lease sales. Most hydropower generating facilities were constructed many years ago. New hydropower facilities associated with existing Reclamation facilities are treated as "lease of power privileges."

Solar

The BLM conducted a comprehensive environmental analysis through which it identified 17 "solar energy zones" (SEZs) on public lands in six Western states where solar energy development would be encouraged.[28] The analysis also identified lands where solar energy development would be excluded and lands where solar energy could be developed if additional analysis showed appropriate. The BLM finalized their land use allocations in October, 2012. The BLM also launched the Restoration Design

[26] http://www.eia.gov/energy_in_brief/article/renewable_electricity.cfm.

[27] The Bureau of Indian Affairs is responsible for the administration and management of 55 million surface acres held in trust by the United States for Indian tribes, individuals, and Alaska Natives. Permitting renewable energy projects on tribal trust lands is handled on a project-by-project basis by the tribal surface owner and various agencies, including BIA and BLM.

[28] Arizona, California, Colorado, Nevada, New Mexico and Utah.

Energy Project (RDEP) in FY 2012.[29] The initiative identified lands across Arizona most suitable for solar and wind power projects, with a focus on disturbed areas, and those with few potential conflicts over natural and cultural resources. A Record of Decision was issued in January 2013 to incorporate land use allocations and programmatic and SEZ-specific design features into eight Arizona BLM land use plans.

In FY 2012, Interior collected $8.4 million in solar rentals, up from $6.8 million in FY 2011. This rental is based on a per-acre "base rent" fee and a per-MW of installed capacity fee. Solar rent is phased in over a five-year period after construction. Most solar projects are photovoltaic facilities, which have the lowest capacity fee. These fees are shown in Table 5-1.

Table 5-1. Solar Capacity Fee, by Technology

Generating Technology	Fee Per-MW of Installed Capacity
Photovoltaic (PV)	$5,256
Concentrated Solar Power (CSP)	$6,570
CSP with Storage	$7,884

Wind

In April 2011, BOEM announced approval of the Construction and Operations Plan for the Cape Wind project, the nation's first commercial lease to construct and operate an offshore wind facility located in Federal waters. The project consists of 130 turbines, each rated at 3.6 MW, for a total capacity of 468 MW. The 33-year lease covers 46 square miles in Nantucket Sound offshore Massachusetts, and will cost Cape Wind Associates, LLC $88,278 in annual rental payments prior to energy production, then annual operating fees of 2 to 7 percent once production has commenced. The annual fee is based on an estimate of the wholesale electric power price Cape Wind's power would receive in regional markets.

In October 2012 BOEM reached agreement with Bluewater Wind Delaware, LLC on a commercial wind energy lease for about 100,000 acres of the Outer Continental Shelf (OCS) offshore Delaware. Bluewater has proposed a 450-megawatt project – which could power over 100,000 homes – located to avoid shipping lanes, a proposed vessel anchorage ground and a munitions disposal area. BOEM will assess the plans based on environmental, technical and other factors before granting approval for construction.

BOEM has also issued leases for the OCS off of New Jersey to Deepwater Wind, LLC and Fishermen's Energy of New Jersey, LLC. These leases were made under the "interim policy" that pre-dated the 2009 Final Renewable Energy Framework governing management of the Renewable Energy Program. These 5-year leases were designed for resource data collection and technology testing, and convey no commercial rights.

[29] See http://www.blm.gov/pgdata/etc/medialib/blm/az/pdfs/energy/rdep.Par.61617.File.dat/faq.pdf and http://www.blm.gov/pgdata/etc/medialib/blm/az/pdfs/energy/rdep.Par.61787.File.dat/RDEP-ROD-ARMP.pdf for more information.

In FY 2012, Interior collected $1.6 million in wind rentals, up from $1.5 million in FY 2011. This rental is based on a fee of $4,155 per-MW of installed capacity. Wind rent is phased in over a three-year period after construction.

Geothermal

The BLM has authority for leasing 245 million acres of public lands with geothermal potential in 11 Western States.[30] This includes 104 million acres of National Forest lands. As of January 2013, the BLM manages 818 geothermal leases, including 59 producing leases with 1,275 megawatts of installed capacity; over 40 percent of U.S. geothermal energy capacity. Since the completion of a 2008 Programmatic EIS, the BLM has competitively leased over one million acres of federal lands in six states (see Table 5-2). The BLM's geothermal leases generated over 5,266 gigawatt hours of electrical power during 2012 and provided alternative heat sources for direct-use commercial endeavors, enough to power 1.2 million homes.

Table 5-2. Geothermal Leasing by State

State	Number of Parcels	Number of Acres
Nevada	251	724,085
Utah	67	241,490
Oregon	11	41,362
Idaho	13	17,580
California	14	14,110
Colorado	1	799
Total	**357**	**1,039,426**

Source: BLM Geothermal Factsheet (January 2013).

Competitive lease sales since 2007 have netted over $76 million in bonus bids for geothermal lease parcels in California, Colorado, Idaho, Nevada, Oregon, and Utah. Annual geothermal bonuses, rents, and royalties have averaged $11.7 million over 2003-2012. A portion of the bonus bids and royalty revenues are shared with states and counties.[31]

[30] For more details see: http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/energy/solar_and_wind.Par.4837.File.dat/Geothermal_01_2013.pdf

[31] States receive 50% of lease sales and royalty revenues and counties receive 25%.

Project Approvals, Outputs and Price Trend Data

Solar, Wind, and Geothermal – Project Approvals and Generating Capacity

Table 5-3 presents information on renewable energy projects approved and generating capacity. Figure 5-1 shows the locations of solar, wind, and geothermal projects on Federal lands.

Table 5-3. Renewable Projects, Approvals and Capacity

Type of Project	Projects Approved	Capacity (MW)
Geothermal		
To date	46	2,083
Since 2009	9	427
FY 2012	0	0
Solar		
To date	18	5,208
Since 2009	18	5,208
FY 2012[a]	2	489
Wind		
To date	34	3,034
Since 2009	7	2,359
FY 2012	2	1,815
Hydropower, MW		
Lease of power privilege (2011&2012)	8	38.4
Existing capacity		14,692

Source: BLM data.

[a] FY 2012 solar capacity includes a 350 MW project on tribal trust land in NV. Also, not every renewable energy project approved may ultimately be developed.

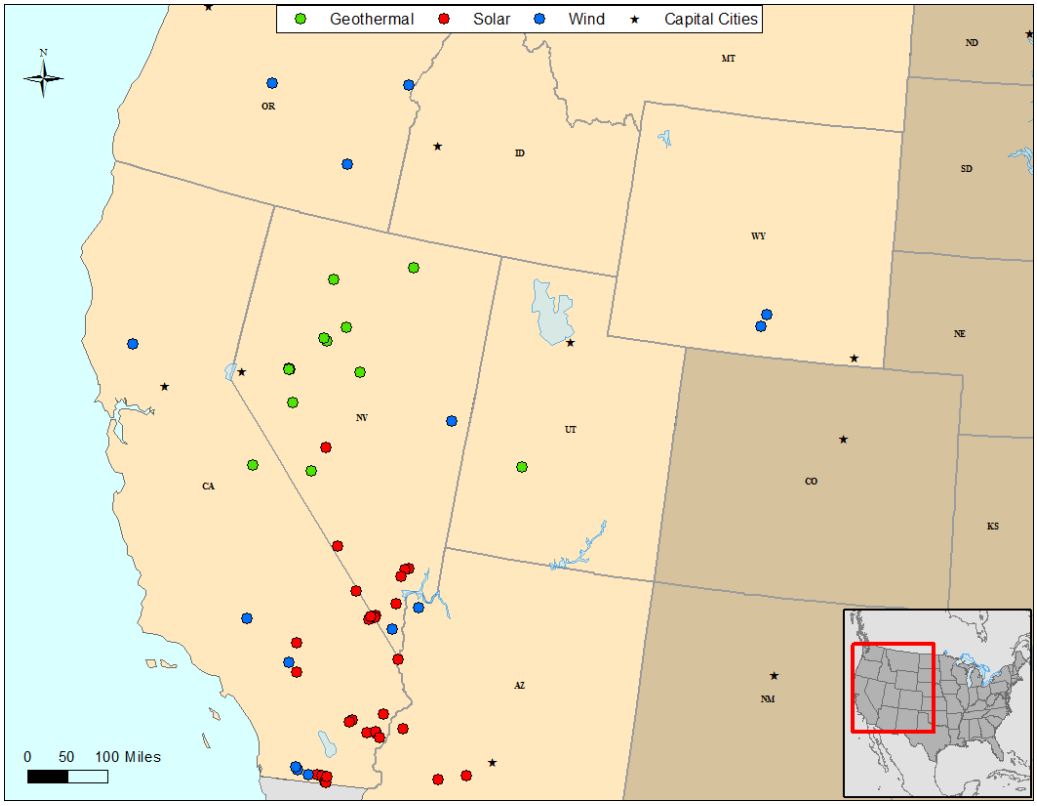

Figure 5-1. Solar, Wind, and Geothermal Energy Projects Approved Since 2009

Source: BLM data.

During FY 2012, BLM approved 5 solar and 2 wind projects with a total 1,504 MW of installed capacity. Geothermal leasing in FY 2012 totaled 8 parcels leased in Nevada and 2 parcels leased in Colorado.[32]

Table 5-4 shows geothermal leasing by state. Of the 1.04 million acres under lease for geothermal energy production, about 70% are located in Nevada. Reclamation operates 194 hydroelectric generating units with an installed capacity of 14,692,930 kilowatts. Net generation from Reclamation hydropower facilities in FY 2012 was about 47.5 MWH, compared to about 48.6 MWH in FY2011.

Table 5-4. Geothermal Leasing by State

State	Number of Parcels	Number of Acres
Nevada	251	724,085
Utah	67	241,490
Oregon	11	41,362
Idaho	13	17,580
California	14	14,110
Colorado	1	799
Total	**357**	**1,039,426**

Source: BLM Geothermal Factsheet (January 2013).

[32] http://www.blm.gov/wo/st/en/prog/energy/geothermal.html.

There has been considerable growth in solar, wind, and geothermal capacity in recent years. Figure 5-2 shows the growth in solar, wind, geothermal energy capacity on public lands since 1978.

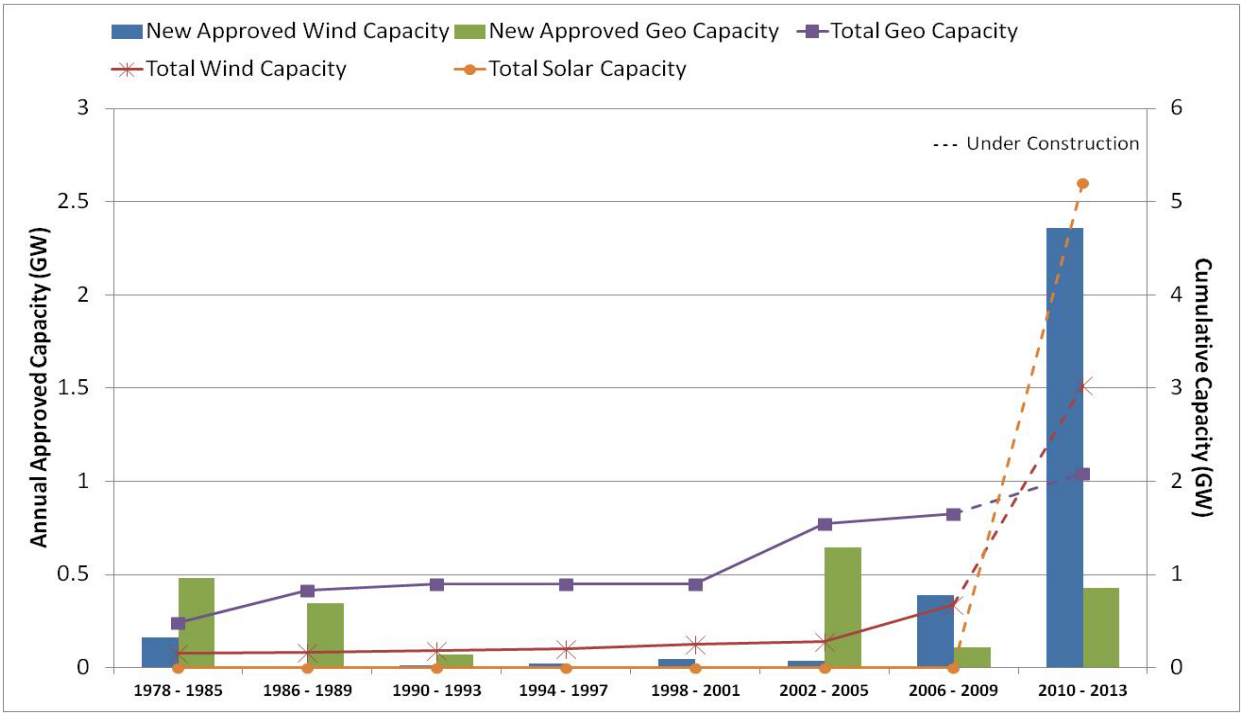

Figure 5-2. Solar, Wind and Geothermal Capacity on Federal Lands (1978-2013)

Source: BLM data.

As shown in Table 5-5, as of February 2013, solar, wind, and geothermal renewable energy developments on public land include 18 solar projects, 34 wind projects, and 46 geothermal projects, with associated transmission corridors and infrastructure that will enable the projects to connect to established power grids. Together, these projects have 10,400 megawatts of generation capacity, exceeding the President's goal of authorizing 10,000 megawatts of utility scale renewable energy on public lands by 2013. The projects will power more than 3 million homes.

Table 5-5. Renewable Projects, Approvals and Capacity

Type of Project	Projects Approved	Capacity (MW)
Geothermal		
To date	46	2,083
Since 2009	9	427
FY 2012	0	0
Solar		
To date	18	5,208
Since 2009	18	5,208
FY 2012[a]	2	489
Wind		
To date	34	3,034
Since 2009	7	2,359
FY 2012	2	1,815
Hydropower, MW		
Lease of power privilege (2011&2012)	8	38.4
Existing capacity		14,692

Source: BLM data.

[a] FY 2012 solar capacity includes a 350 MW project on tribal trust land in NV. Also, not every renewable energy project approved may ultimately be developed.

Hydropower – Project Approvals and Generating Capacity

In the late 1940s hydropower provided a third of U.S. electricity; by 2007 it had fallen to less than 6 percent. For FY 2012, hydropower accounted for about 7 percent of U.S. electricity generation.[33] The 58 hydroelectric power plants at Reclamation facilities generate over 40 billion kilowatt hours of electricity per year, enough to power over 3.5 million homes, and providing nearly a billion dollars in revenues. Figure 5-3 shows net generation at Reclamation operated hydropower facilities over FY 2003-FY 2012.

Reclamation's facilities avoid the production of over 27 million tons of carbon dioxide that result from producing this power by conventional power plants.[34] Reclamation has added approximately 80 megawatts of new hydropower capacity to its portfolio through turbine replacements, generator rewinds, and other projects that improve efficiency at Reclamation power plants. Over the last three years another 36 megawatts of power capacity have been added to Reclamation facilities through lease or license with non-federal entities.

[33] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_01.

[34] FY 2013 U.S. Department of the Interior Budget in Brief, page BH-37.

Since entering into a Memorandum of Understanding in 2010 with the Department of Energy and U.S. Army Corps of Engineers, Interior has documented opportunities to generate nearly two million megawatt hours of new hydropower annually, either through additions to existing Reclamation facilities or through construction of new conduit hydropower systems.[35] Taking advantage of these opportunities, Reclamation has awarded lease of power privilege contracts on Ridgeway Dam and the Uncompahgre South Canal in Colorado.[36]

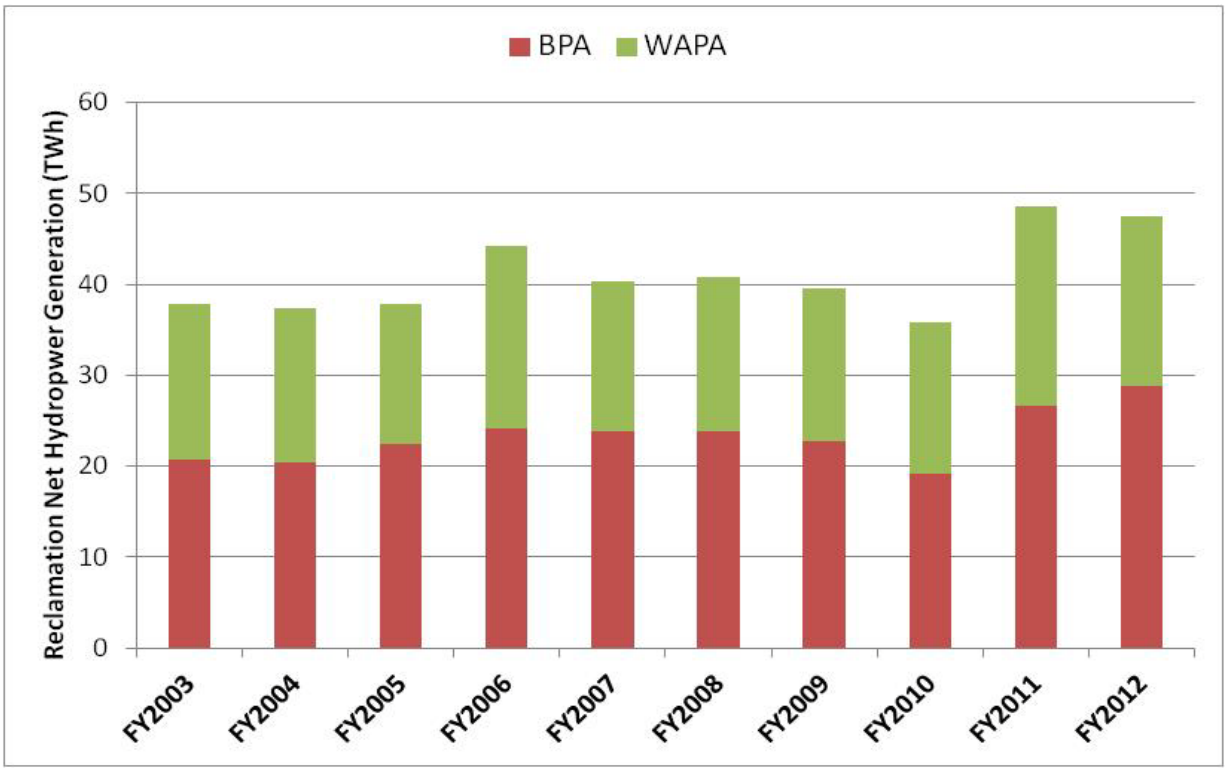

Figure 5-3. Net Generation at Reclamation Operated Hydropower Facilities over FY 2003-FY 2012

Source: Bureau of Reclamation data.

[35] http://www.usbr.gov/power/hydropower-mou/HydropowerMOU.pdf.

[36] Hydropower Resource Assessment at Existing Reclamation Facilities, a comprehensive review of power potential at all Reclamation facilities. See http://www.usbr.gov/power/AssessmentReport/USBRHydroAssessmentFinalReportMarch2011.pdf.

Economic Contributions and Economic Values

Geothermal, wind, solar, and hydro generated energy produced on Interior managed public lands in FY 2012 is estimated to have provided $4.4 billion in economic contributions, and supported about 18,000 jobs (value added information is not readily available).[37] Table 5-6 provides details. In particular:

- The wind energy capacity installed in FY 2012 resulted in over $7 million in direct economic contribution, $80 million in total output, and supported 500 jobs.
- The solar energy capacity installed in FY 2012 is estimated to provide over $560 million in direct economic contribution, $1.7 billion in total output and support 8,000 jobs.
- Geothermal energy production resulted in $240 million in direct economic contribution, $491 million in total output and supported over 2,500 jobs.
- Hydropower production was associated with value added of about $1.7 billion, economic contributions of about $2.1 billion, and about 6,700 jobs.

Table 5-6. Renewable Energy – Contributions and Value Added

Energy Source	Estimated Sales Value of Electricity Produced	Estimated Value Added	Estimated Economic Contribution	Estimated Employment Supported
		($ billions)		(number)
Wind[1]	$0.06	n/a	$0.08	466
Solar[1]	$0.15	n/a	$1.7	8,423
Geothermal	$0.29	$0.33	$0.49	2,539
Hydropower	$1.46	$1.7	$2.1	6,700
Total	$1.96	$2.03	$4.37	18,128

[1]Estimates calculated using installed capacity, capacity factor and average on-peak spot electricity prices for capacity installed in FY 2012.

The economic benefit of operating a renewable energy plant can be measured by the avoided cost, with the market price of electricity as a proxy for avoided cost. Avoided cost is the difference between the total power system cost of satisfying the demand for electricity "with" and "without" operating the plant. The market price of electricity reflects the cost of operating the marginal, or price-setting generation unit. For example, at a given level of electricity demand, generation of an additional

[37] Economic contributions associated with wind, solar, and geothermal energy produced on BLM land arise in the following manner. BLM issues permits for activities or sells leases. In the case of competitive lease sales, bonus bids and related revenues are transferred from companies to ONRR, and subsequently to Treasury, States, and Tribes. Companies pursue exploration and development and construct the power plants. These activities involving hiring labor and capital and may degrade various nonmarket goods and services; however, they may also offset degradation that would have occurred from developing and using fossil fuels. Companies produce power and during the production phase labor and capital are reduced to operating levels; power-purchase revenues fund the rental/royalty revenues paid to ONRR, and then to Treasury, States, Tribes, and grant recipients. This generation offsets impacts associated with fossil-fuel emissions.

megawatt hour of hydropower may avoid the costs associated with generating that power with a gas- or coal-fired generation unit.

The cost of operating a generation facility varies with the time of day. The variable cost of meeting demand varies on a second by second basis depending on the load, as well as the type and load-level of plants in operation. During off-peak periods, demand is typically satisfied with lower-cost coal, run-of-river hydropower, and nuclear units. During on-peak periods, the additional load is met with more expensive sources such as natural gas combustion turbine units. In aggregate, generating electricity by renewable energy reduces the amount of electricity supplied by fossil fuel plants, along with the associated emissions. Market values of power typically do not consider the effects, if any, of changing energy generation levels on system-wide powerplant emissions, regional air quality, or other external costs associated with the siting and operation of renewable energy facilities.

Chapter 6 Water

Introduction

Water is vital to a productive and growing economy in the United States, directly and indirectly affecting the production of goods and services in many sectors. Agriculture, energy production and the public supply of water account for more than 90 percent of off-stream water use in the United States.[38] Within the U.S. Department of the Interior (DOI or Interior), the Bureau of Reclamation (Reclamation) and the Bureau of Indian Affairs (BIA) both provide water for a variety of uses in the West. The following provides an overview on Reclamation and BIA's water supply activities and issues associated with the supply and demand for water.

Interior stores and delivers water for irrigation, municipal and industrial (M&I), and other uses. The value of water varies widely according to location, type of use and climatic conditions. Interior's irrigation and M&I water activities are associated with:

- $27 billion in value added;
- $47.4 billion in output; and
- supported an estimated 339,000 jobs.

Interior also delivers water to support in-stream flows, wildlife refuges, and other uses that are difficult to fully value.

Background

Water Withdrawals

The most recent data (Kenny et al., 2009) indicates that about 410 billion gallons per day (Bgal/d) of water was withdrawn for use in the United States during 2005. Figure 6-1 and Figure 6-2 show water use over 1950-2005.[39] About 80 percent of the total (328 Bgal/d) withdrawal was from surface water, and about 82 percent of the surface water withdrawn was freshwater. The remaining 20 percent (82.6 Bgal/d) was withdrawn from groundwater, of which about 96 percent was freshwater. If withdrawals for thermoelectric power in 2005 are excluded, withdrawals were 210 Bgal/d, of which 129 Bgal/d (62 percent) was supplied by surface water and 80.7 Bgal/d (38 percent) was supplied by groundwater.

Thermoelectric power has been the category with the largest water withdrawals since 1965, and for 2005 made up 49 percent of total withdrawals. Irrigation is the second largest category of water use, after thermoelectric. In 1950, irrigation withdrawals of about 89 Bgal/d accounted for about one-half of all water use and 64 percent of use excluding thermoelectric. By the peak year of 1980, irrigation withdrawals totaled 150 Bgal/d and represented 35 percent of total use and 68 percent of the total excluding thermoelectric.

[38] EPA, Value of Water, 2012.

[39] The source of both figures is: Table 14, Trends in estimated water use in the US, 1950-2005. Estimated Use of Water in the United States, Circular 1344, U.S. Department of the Interior, U.S. Geological Survey, 2009.

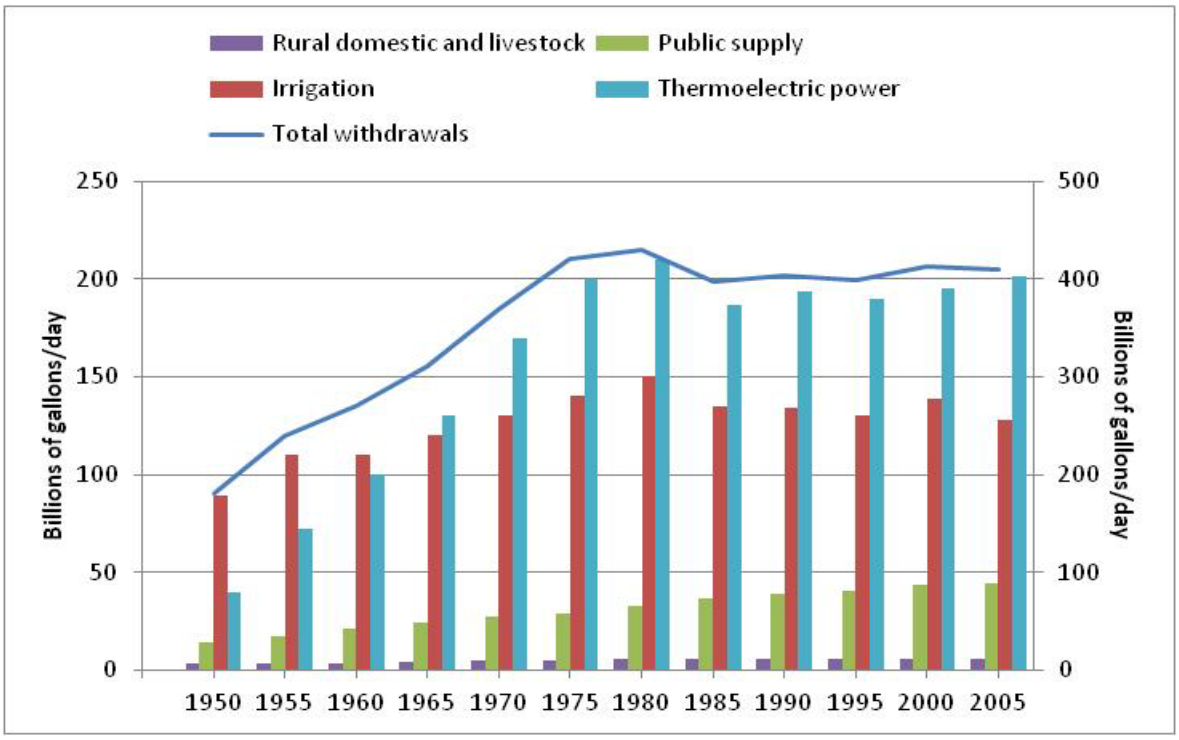

Figure 6-1. Water Withdrawals, 1950-2005

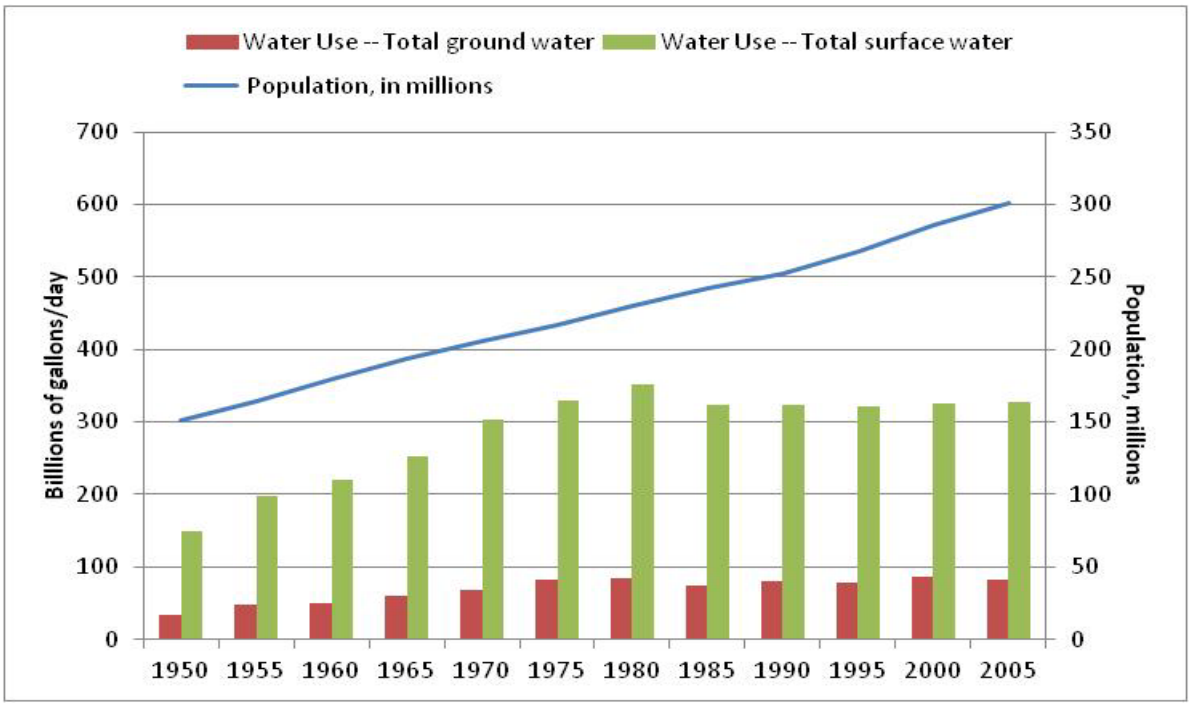

Figure 6-2. Population, Surface and Groundwater Use

Source for both figures: Table 14, Trends in estimated water use in the U.S., 1950-2005. Estimated Use of Water in the United States, Circular 1344, U.S. Department of the Interior, U.S. Geological Survey, 2009.

Agricultural activities, which include crop irrigation, livestock watering, and aquaculture, withdraw approximately 140 billion gallons of water per day, and consume the largest quantity of water of any sector in the U.S. economy (USGS, 2009). Access to water is vital to agricultural productivity, particularly in the arid and semi-arid regions of the Great Plains and the West, where irrigation projects bolster the international competitiveness of U.S. farms.[40]

Irrigated agriculture makes a significant contribution to the value of U.S. agricultural production. In 2012, the cash receipts from crops and livestock was estimated to be about $385.5 billion.[41] Based on 2007 Census of Agriculture data, irrigated farms accounted for $118.5 billion in sales, or roughly 40 percent of the value of U.S. agricultural production.[42] Applying this proportion to the value of production in 2012, irrigated agriculture is estimated to account for approximately $154.2 billion in sales.

Water Allocation and Transfers

Water is generally allocated via administrative mechanisms, often at the state level, rather than by markets. In the Western United States the prior appropriation doctrine allocates water first to the earliest users, which are frequently agricultural. Market mechanisms may allow transfer of such valuable rights to higher value municipal and industrial uses. The price paid for water delivery does not always fully reflect the opportunity costs associated with using the resource.

The Western States Water Council (WSWC) recently conducted a survey of its member states on the subject of water transfers. Of the 17 states the WSWC surveyed, three-quarters indicated that transfers are important for water allocation and will likely be used to meet future water demand. Data available for the Western states show that all states have experienced water transfers, but some more than others. Colorado has a large number of smaller-volume transactions. California has the largest volume traded.[43] In particular, active markets are found in Northern Nevada, California, the service area associated with the Bureau of Reclamation's Colorado-Big Thompson project, and the Lower Rio Grande Valley. There are both demand and supply side drivers of water transfers. These can include:

- Demand side: urban growth; energy development; drought and scarcity as well as market trends in the agricultural sector; preservation and enhancement of fish and wildlife habitat.
- Supply side: farmers seeking to “diversify their portfolios,” effectively using water as another crop; and urban areas that may have accumulated water rights to meet projected growth can lease out that water in interim years with low demand or wet conditions.

Water banks exist in almost all western states. While there are significant differences in the way banks operate, the common goal is moving water to where it is needed most. Water banking is emerging as an

[40] EPA Value of Water, Public Review Draft 9/12.
[41] Income statement for farm sector, 2008-2012F, Economic Research Service, USDA. http://www.ers.usda.gov/datafiles/Farm_Income/US_Farm_Income_and_Wealth_Statistics_includes_the_US_Farm Income_Forecast_2012/Nf_t2-rto.pdf.
[42] Schaible, Glenn, Aillery, Marcel. 2012. Water Conservation in Irrigated Agriculture: Trends and Challenges in the Face of Emerging Demands. USDA Economic Research Service Economic Information Bulletin Number 99.
[43] The Western Governors’ Association. December 2012. *Water Transfers in the West Projects, Trends, and Leading Practices in Voluntary Water Trading*.

important management tool to meet growing and changing water demands throughout the United States. Like other forms of temporary water transfers, water banks can help make water supplies available to meet critical needs, especially during dry years.[44]

Demand and Supply Issues

Population and economic growth, changing social values with respect to water quality and the environment, and Native American water right claims have been and will continue to be forces driving demand for water resources within the United States. Continued and increased energy developments with the associated water requirements for hydraulic fracturing, processing, or refining, is likely to increase water demand in affected areas. In addition, energy production and biofuel development may also increase demand for water resources in some regions. Over time, climate change impacts are expected to alter both water supplies and water demands across and within regions. Warming temperatures, changing precipitation patterns, and reduced snowpack are expected to significantly reduce late spring/summer streamflows (flows that historically were available for reservoir storage to meet peak irrigation water demands) and groundwater recharge across much of the West. In addition, higher temperatures are expected to increase crop-water demands via reduced crop ET efficiency.[45]

Temperature and precipitation conditions over Western U.S. regional drainages are projected to change as the effects of global climate change are realized. Climate models suggest that over any of the regional drainages temperatures are projected to increase during the 21st century. Some climate models suggest increases in precipitation while others suggest decreases. Much of the Western United States experienced warming during the 20th century (roughly 2 degrees Fahrenheit) and is projected to experience further warming during the 21st century with central estimates varying from roughly 5–7 °F, depending on location. As related to precipitation, historical trends in annual conditions are less apparent. These historical and projected climate changes have implications for hydrology (e.g., potentially more rain and less snow in some basins).[46]

Outputs

Reclamation maintains 476 dams and 348 reservoirs with the capacity to store 245 million acre-feet of water, and manages water for agricultural, municipal, and industrial use, and provides flood control and recreation for millions of people. Reclamation manages water for agricultural, municipal, and industrial use, and provides flood control and recreation for millions of people. More than 42 million acres, or roughly 75 percent, of the more than 56 million acres of irrigated land in the U.S. are located in the 17 western Reclamation states. Moreover, Reclamation facilities deliver water to approximately one-fourth of the irrigated land in the west, (or about ten million acres) and provide approximately 10 trillion gallons to over 31 million people for municipal and industrial uses and other non-agricultural uses.[47]

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[44] Analysis of Water Banks in the Western States, Washington Department of Ecology (2004), available at, http://www.ecy.wa.gov/pubs/0411011.pdf.

[45] Schaible, Glenn, Aillery, Marcel. 2012. Water Conservation in Irrigated Agriculture: Trends and Challenges in the Face of Emerging Demands. USDA Economic Research Service Economic Information Bulletin Number 99.

[46] Reclamation, SECURE Water Act Section 9503(c) – Reclamation Climate Change and Water, Report to Congress, 2011.

[47] See: http://www.usbr.gov/facts.html.

Reclamation facilities also reduce flood damages in communities where they are located and thereby create an economic benefit by sparing these communities the cost of rebuilding or replacing property damaged or destroyed by flood events. The value of avoided flood damages for each region is about $1.2 million per year. [48]

Western rivers provide Native Americans with water for irrigation, domestic, municipal, rural, and industrial water projects. Water also provides important fish and wildlife habitat, and supports cultural, historic, and religious uses for tribes. BIA manages 17 irrigation projects on Indian reservations in the western United States which serve approximately 25,000 users. These projects, which were generally constructed in the late 1800s and early 1900s, include water storage facilities and delivery structures for agricultural purposes. Total irrigated acres are approximately 750,000. More recently, the Bureau of Reclamation has also designed and constructed a number of rural water projects to serve Native Americans. However, BIA's water management roles go beyond providing water facilities and storage and include trust management responsibilities which are also important to local economies.

Reclamation delivered an estimated 28.4 million acre-feet of water in FY 2012. Data are not readily available to comprehensively allocate those deliveries among different purposes or across Reclamation projects. However, as a point of comparison, Reclamation delivered an estimated total of 28.5 million acre-feet in 1992, with 23.8 million acre-feet for irrigation (83.5%), 2.8 million acre-feet for M&I use (9.8%), and 1.9 million acre-feet for other nonagricultural uses (6.7%).[49] Municipal and industrial uses typically include uses customarily found in the operation of municipal and community water systems and for uses in industrial processes. Industrial processes can include thermal power generation and mining operations. Municipal uses include household, commercial and public supplies.

Value Added, Economic Contributions and Economic Values

For FY 2012, the estimated value added, economic contributions, and employment associated with Reclamation's and BIA's water supply activities are summarized in Table 6-1.

Table 6-1. Water Deliveries – Economic Contributions and Value Added

Activity	Estimated Value Added ($ billions)	Estimated Economic Contribution ($ billions)	Estimated Employment Supported (number)
Irrigation – Reclamation	22.6	42	305,256
Irrigation – BIA	0.5	1.1	9,758
M&I - Reclamation	3.7	4.3	24,000
Total	26.8	47.4	339,014

It is difficult to determine the economic value of water because the values depend upon multiple dimensions (the volume supplied; where and when it is supplied; the reliability of supply; and water quality considerations) and because in most instances market values are not available. For water

[48] See: http://www.usbr.gov/facts.html.

[49] 1992 Summary Statistics, Water, Land, and Related Data. U.S. Department of the Interior, Bureau of Reclamation. Nonagricultural uses include irrigation of urban and suburban areas; water for stock, fish, and wildlife; and construction uses under temporary contracts.

supplied by Reclamation and BIA facilities, a number of additional factors (e.g., varying irrigation technology; considerations related to water rights and water use law; subsidization of public water supply projects; competition from other users; climate change; commodity prices; and the structure and nature of global food demand) make valuation challenging.

Economists have developed a variety of approaches to estimate the value of a unit of water used in the agricultural sector. These values vary widely due to the estimation methods and the specific aspects of water value that each method captures. The methods include acquisition cost; the factor input method (this method incorporates the relationship between crop yield and water input and yield increases can be valued by commodity prices to provide an estimate of the value of water as an input to production); examining data from water transfers; and the hedonic price approach. EPA (2012) presented the following average values:

- Public supply and domestic self-supply: up to $4,500 per acre foot;[50]
- Agriculture: $12 to $4,500 per acre foot;
- Manufacturing: $14 to $1,600 per acre foot;
- Thermoelectric cooling: $12 to $87 per acre foot;
- Hydropower: $1 to $157 per acre foot; and
- Mining and energy resource extraction: $40 to $500 per acre foot.

These value estimates are "average" values, not "marginal" values.[51] These values reflect values arising from the *use* of water. Water also has value when left instream to support ecosystem functions, such as dilution of wastes, channel maintenance, and enhancement of fish and wildlife habitat. There may also be some nonuse value attributable to the knowledge that the river has sufficient flow; this value could reflect, among other things, concerns for the ecological integrity of the aquatic environment. These values have been estimated by a number of studies[52]

Preserving or restoring damaged ecosystems in arid regions often involves water acquisitions to provide instream flows for wetlands and to maintain and enhance endangered species habitat. For example, under the Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990 (P.L. 101-618) Congress directed the Secretary of the Interior to acquire by purchase or other means, enough water to sustain 25,000 acres of primary wetland habitat in the Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Fallon Paiute-Shoshone Reservation wetlands, all within Churchill County, Nevada. In order to meet the 25,000 acre objective, the FWS has determined that an annual average of 125,000 acre-feet of water will be needed. Of this total, FWS expects to purchase up to 75,000 acre-feet, with the balance provided from irrigation project drainwater, reservoir spills, and

[50] $4,500 would represent an extreme upper bound that would only be observed infrequently and in special circumstances (say where irrigated land is located on the fringe of a growing metropolitan area).

[51] There are wide variation in values, depending upon the crop in question, the region of the country, and other factors. Some studies have found irrigation water values of zero, while upper-bound values approached $1,000 per acre foot for some crops. Data on water transfers (Brewer 2007) yields a wide range of values, depending on the specific conditions of the transfer, with the average price associated with a temporary agricultural lease of approximately $30 per acre-foot. Source: EPA, Office of Water, December 2012.

[52] Some examples include the economic analysis conducted for the Secretarial Determination to remove four dams on the Klamath River; and NPS's assessment of the effects of the re-regulation of Glen Canyon dam on resources of the Grand Canyon.

other sources (U.S. DOI, 1996). Figure 6-3 shows annual water acquisitions and costs per acre-foot to help support the wetlands in Stillwater National Wildlife Refuge and the Lahontan Valley. As of the end of 2012, FWS had acquired about 39,000 acre-feet of water. The cost of acquiring water has risen in nominal terms from around $500 per acre-foot in the 1990s to over $1,300 per acre-foot in recent years. The increase in prices reflects demand for development, both for residential and dairy, and the recognition that water rights have considerable future value.

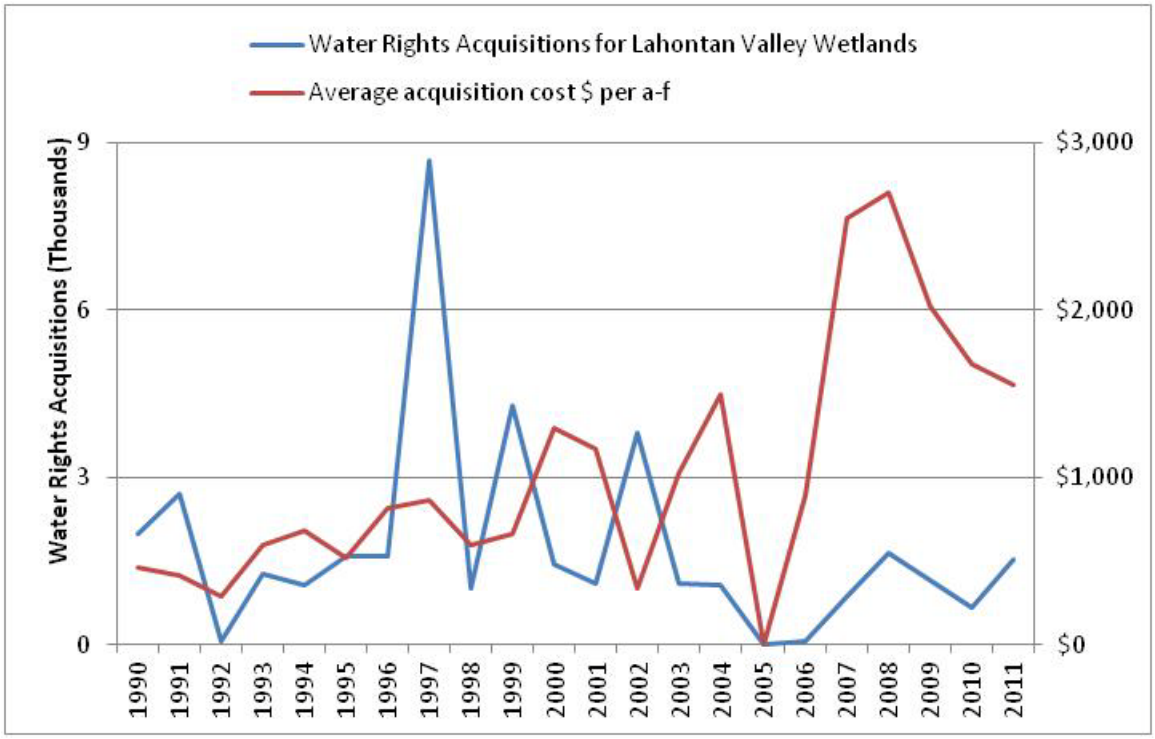

Figure 6-3. Lahontan Valley Water Rights Acquisitions

Source: FWS data.

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Chapter 7 Non-Fuel Minerals

Introduction

Non-fuel minerals mined on public and Indian lands provide vital inputs that are used throughout the economy. Public and Indian lands administered by the BLM and BIA are an important source of many of these minerals. A wide variety of minerals can be classified as "non-fuel", including precious metals, base metals, industrial minerals, and materials used for construction. The General Mining Law of 1872 declared all valuable mineral deposits in public land to be free and open to exploration and purchase. These minerals may be "located" with a mining claim under the law. "Locatable" minerals include both metallic minerals (gold, silver, lead, copper, zinc, nickel, etc.), nonmetallic minerals (fluorspar, mica, certain limestones and gypsum, heavy minerals in placer form, uranium, bentonite, silica sand, and gemstones) and certain uncommon varieties of minerals (e.g. dimension stone, pumice, pumicite, and cinder deposits). Other minerals include those often used as industrial feedstock such as phosphate, sodium, and potassium. Mineral materials include sand, gravel, dirt, and rock.

In FY 2012, Interior-lands produced a wide variety of minerals. For example, it is estimated that over 3 million ounces of gold were produced from Federal lands; the average price of gold in 2012 was $1,700 per ounce. The economic contribution estimates associated with non-fuel mineral production are:

- Value added of $13 billion;
- Estimated output of $21 billion; and
- Estimated employment supported of 111,000.

While minerals are generally traded in competitive markets (though some markets may be localized or thin), prices may not incorporate the external costs associated with mining. Nor does the Federal leasing system completely offset these costs, which are primarily associated with the environmental impacts of mining.

No royalties are associated with the production of locatable minerals produced on lands covered by the Mining Law of 1872. Minerals and materials such as phosphate, sodium, potash, sand, gravel, and rock are leased or sold to the public at fair market value.

At the end of FY 2012 there were 406,140 active mining claims on public land. About 50% of these claims are located in Nevada. Most of the value associated with locatable mineral production is attributable to gold which is produced in significant quantities on public lands.

Outputs

Information and trends associated with a number of selected minerals mined on public land are presented below.[53]

[53] The source of much of the information on U.S. production, prices, and value of production is USGS Mineral Commodity Summaries, various years.

Table 7-1 presents data over 2003 – 2012 commodities for the minerals produced on federal lands that have sales values exceeding $100 million. In general, data for locatable minerals are not presented because ONRR does not collect sales volume and value data for locatable minerals covered under the 1872 Mining Law. USGS collects data on total U.S. production for most minerals and some of this information is presented below. For minerals where ONRR data is available, in FY 2012, the largest sales values were associated with carbon dioxide ($567 million); soda ash ($833 million); potash ($265 million); and langbeinite ($230 million).[54]

[54] Langbeinite is a potassium magnesium sulfate mineral and is used to produce potash. Potash is an input for many chemicals and fertilizers.

Table 7-1. Sales Values for Selected Minerals Produced on DOI Managed Lands, 2003-2012

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Carbon Dioxide Gas (CO2) (mcf)	177.18	211.88	260.57	303.57	306.99	440.38	582.28	479.96	572.94	567.13
Copper (and Cu concentrate)	16.32	42.25	44.86	49.02	57.59	28.01	302.62	237.44	125.12	49.20
Langbeinite (incl coarse, granular, special std, standard)	70.61	79.70	77.06	41.57	118.10	51.37	333.82	150.24	163.25	230.38
Lead Concentrate (ton)	21.78	61.82	78.11	104.17	187.71	296.31	130.37	209.73	243.96	175.25
Muriate of Potash (coarse, granular, standard)	101.75	50.12	121.90	89.93	124.28	163.00	207.52	190.73	253.97	265.25
Phosphate (concentrate and raw ore)	86.45	68.93	83.27	41.39	42.64	45.73	64.24	163.21	180.12	205.63
Potash (ton)	89.40	30.00	64.07	(22.45)	85.93	30.08	217.23	113.38	117.76	148.10
Soda Ash (incl granular)	297.06	204.82	347.19	526.00	625.26	935.37	887.38	884.42	1,004.88	833.43
Sulfur (incl geothermal)	8.77	10.95	9.79	15.36	7.29	102.02	44.85	23.58	60.80	83.91
Other minerals	104.27	98.09	86.90	139.25	187.91	151.88	145.88	200.13	267.36	244.42
Grand Total	**1,097.86**	**979.15**	**1,317.63**	**1,445.51**	**1,884.60**	**2,413.07**	**3,058.24**	**2,489.88**	**3,440.27**	**2,978.62**

Source: ONRR data.

Gold

Production and prices: Figure 7-1 shows U.S. gold production and prices over 2001 – 2012. Prices rose from about $200 per troy ounce to $1,700 per troy ounce over this period. Domestic gold mine production in 2012 was estimated to be 230 metric tons, slightly less than the 234 metric tons produced in 2011.[55] In 2012, the value of U.S. gold mine production was about $12.6 billion. This compares to a value of $71.8 billion in 2011. Gold is a locatable mineral under the 1872 Mining Law and thus no royalties are collected on gold mined on public land. Commercial-grade refined gold came from about 2 dozen producers. A few dozen companies, out of several thousand companies and artisans, dominated the fabrication of gold into commercial products.[56] The behavior of gold prices and gold production differ from that of other mineral commodities because gold is often used by investors to hedge against inflation, economic or political instability, and/or uncertainty. For example, during the 2008 financial crisis, while the prices for many minerals were falling, gold prices continued to increase. The price of gold is influenced by a diverse set of factors including U.S. macroeconomic conditions and the value of the dollar.

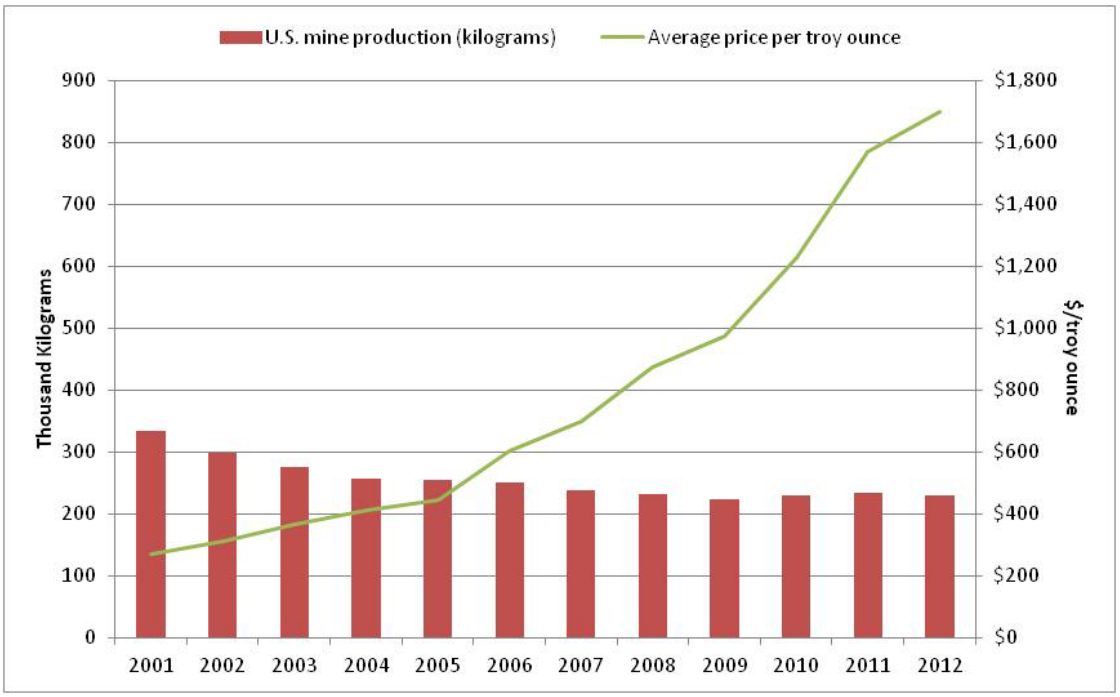

Figure 7-1. Gold Production and Prices, 2001 – 2012

Source: USGS Mineral Commodity Summaries.

[55] The decreases were mainly from one mine in Nevada and one mine in Utah. These decreases were partly offset by several mines in Nevada that increased the tonnage of ore processed, and one mine in Montana that reached normal operations level after a period of redevelopment in 2010 and 2011. See USGS Mineral Commodity Summaries, Gold. http://minerals.usgs.gov/minerals/pubs/commodity/gold/mcs-2013-gold.pdf.

[56] U.S. Geological Survey, Mineral Commodity Summaries, January 2012.

A significant proportion of the gold produced in the U.S. is mined on public land (approximately 40%). In 2012, gold was produced at about 50 U.S. lode mines, a few large placer mines (all in Alaska), and numerous smaller placer mines (mostly in Alaska and in the Western States). Thirty operations yielded more than 99% of the gold produced in the United States. A small amount of gold is recovered as a byproduct of processing base metals, chiefly copper. Nevada accounted for about 75% (142,000 kg) of U.S. gold production in 2012 (as of October 2012).57 Alaska accounted for a further 12% (22,300) of 2012 U.S. production. Production in other states (AZ, CA, ID, MT, NM, SD, UT, and WA) represented 13% (25,100 kg) of mine production.

Uses: Gold is fabricated into commercial products, used in jewelry making, dental applications, and electronics. Gold is also held for investment purposes.

[57] http://www.mineweb.co.za/mineweb/content/en/mineweb-usa?oid=170258&sn=Detail.

Silver

Production and prices: Figure 7-2 shows U.S. silver production and prices over 1999 – 2012. Prices have risen sharply since 1999 from about $5 per troy ounce to $30 per troy ounce in 2012. Domestic silver mine production has declined over the past 13 years. Production in 1999 was about 1,950 metric tons. Production fell to an estimated 1,050 metric tons in 2012, slightly less than the 1,120 metric tons produced in 2011. In 2012, the value of U.S. silver production was about $1.01 billion. This compares to a value of $1.27 billion in 2011. A significant proportion of the value of the silver mined in the U.S. is associated with silver mined on public lands (approximately 35%). No royalties are collected on silver mined on public lands. A portion of the decline in prices and production is related to long-term trend declining industrial demand; a portion is also likely to be related to the recent economic downturn.

Uses: Silver's traditional use categories include coins and medals, electrical and electronics, jewelry and silverware, and photography. In 2012, the estimated uses were electrical and electronics, 35%; coins and medals, 25%; photography, 10%; jewelry and silverware, 8%; and other, 22%.

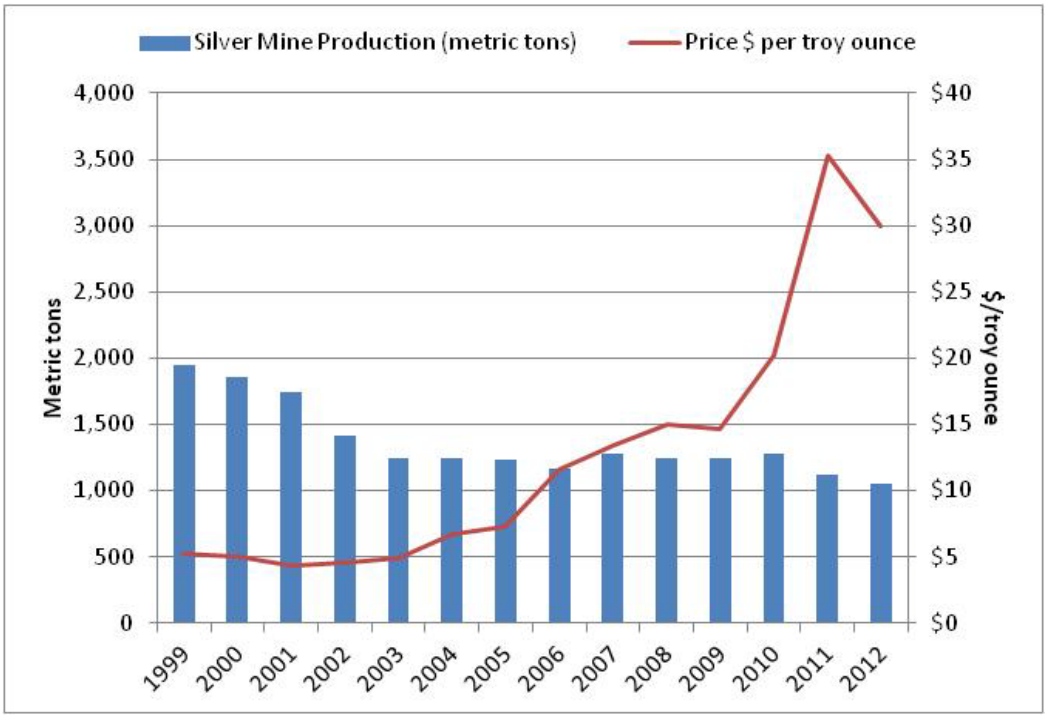

Figure 7-2. Silver Production and Prices

Source: USGS Mineral Commodity Summaries.

Platinum

Production and prices: Almost all of the platinum mined in the U.S. is produced from public lands. Figure 7-3 shows total U.S. quantities mined and prices over 2001-2012. The quantity of platinum mined in 2012 was the same as the quantity mined in 2011, 3,700 kg. However, prices have risen sharply since 2008, from about $350 per ounce in 2007 to about $1580 per ounce in 2012.

Uses: The leading demand sector for platinum group metals (PGMs) continued to be catalysts to decrease harmful emissions in both light- and heavy-duty vehicles. PGMs are also used in the chemical sector as catalysts for manufacturing bulk chemicals such as nitric acid and in the production of specialty silicones; in the petroleum refining sector; and in laboratory equipment, including crucibles for growing high-purity single crystals for use in the electronics sector. Also in the electronics sector, PGMs are used in computer hard disks to increase storage capacity, in multilayer ceramic capacitors, and in hybridized integrated circuits. PGMs are used by the glass manufacturing sector in the production of fiberglass, liquid crystal displays, and flat-panel displays. Platinum alloys, in cast or wrought form, are commonly used for jewelry. Platinum, palladium, and a variety of complex gold-silver copper alloys are used as dental restorative materials. Platinum is also often used as a hedging device. The demand for platinum has also been sustained at a high level due to Asian demand for use in catalytic converters.

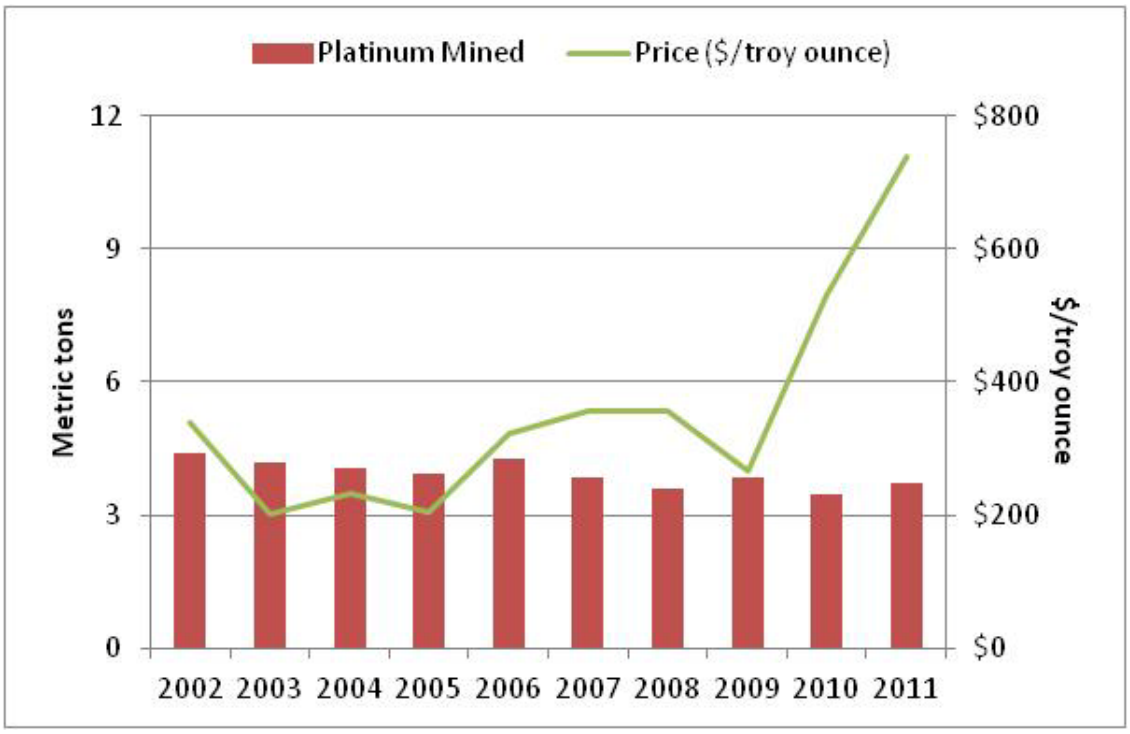

Figure 7-3. Platinum Mined and Prices

Source: USGS Mineral Commodity Summaries.

Soda Ash

Production and prices: Figure 7-4 shows U.S. soda ash production and prices over 1999 – 2012. Prices rose from about $76 per metric ton to $147 per metric ton over this period. Domestic soda ash mine production in 2012 was estimated to be about 10.9 million metric tons, slightly more than the 10.7 million metric tons produced in 2011. Much of, but not all, soda ash is produced from federal lands. In 2012, the total value of U.S. soda ash mine production was about $1.6 billion. The royalty on soda ash produced on public land ranges from 5-8%. In 2012, royalty collections were $41 million, based on a

sales value of about $833 million.[58] The U.S. has the world's largest natural deposit of trona and is the world's second ranked soda ash-producing nation.[59] Of the various sodium compounds and related products affected by the provisions of the Act, soda ash represents at least 80 percent of the total production, sales, and sales revenues. In 2012, the U.S. soda ash industry consisted of five companies. Four of these companies operate five plants in Wyoming that produced soda ash from underground trona ore. One company in California produces soda ash from sodium-carbonate rich brines. Plants in Wyoming and Colorado produce sodium bicarbonate using feedstock from Wyoming.

Uses: Soda ash is an important industrial compound used to manufacture chemicals, glass, pulp and paper, soaps and detergents, and many other familiar consumer products. As fast growing economies, India and China are large consumers of soda ash.

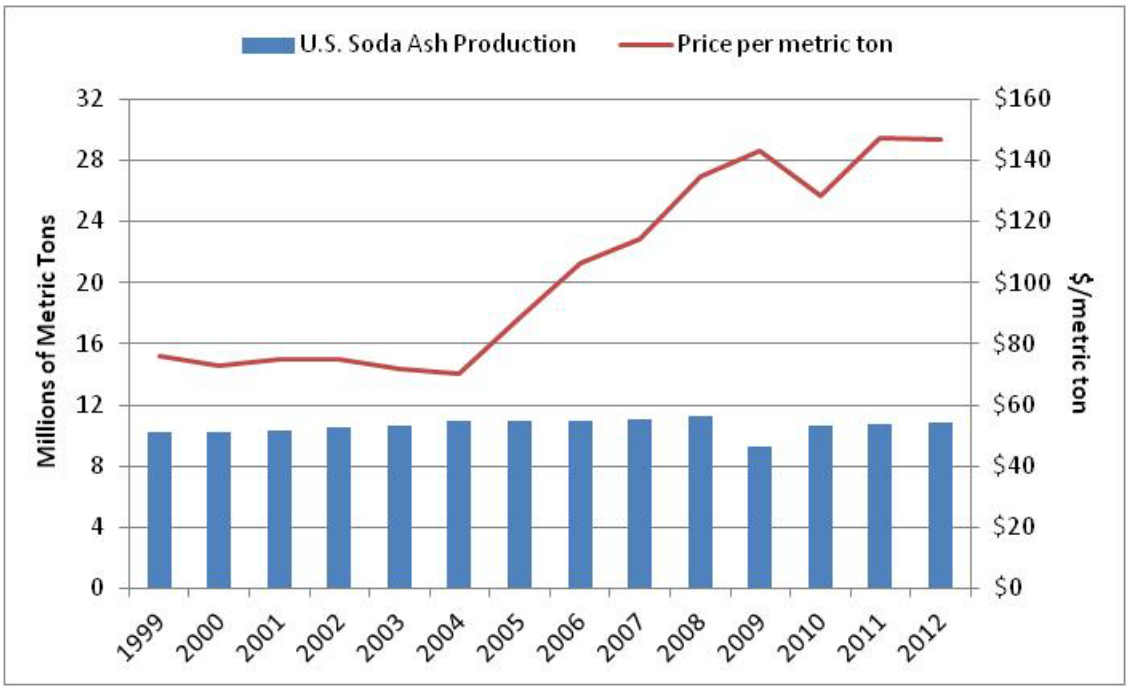

Figure 7-4. Soda Ash Production and Prices

Source: USGS Mineral Commodity Summaries.

Lead

Production and prices: Figure 7-5 shows lead production and prices over 2001 – 2012. Production in 2012 of 345,000 metric tons was slightly higher than the 342,000 metric tons produced in 2011. Most lead is produced on private lands or from federal leases associated with lands managed by the USDA Forest Service. Lead is typically treated as a locatable mineral. One exception is the lead produced from leases in the Mark Twain National Forest in Missouri, the source of 48% of the Nation's mined lead over

[58] Office of Natural Resource Revenue. See http://statistics.onrr.gov.

[59] Soda ash is an alkali chemical refined from the mineral trona or naturally occurring sodium carbonate-bearing brines (natural soda ash) or manufactured from one of several chemical processes (synthetic soda ash). The world's largest deposit of trona is in the Green River Basin of Wyoming.

the past decade. BLM administers leases on Forest Service lands, and ONRR reports a 2012 sales volume of 171,550 tons of lead concentrate. The price of lead has fluctuated over 2001 – 2012 from a low of $0.21 per pound in 2001 to a high of $1.24 per pound in 2007. The average price in 2012 was $1.14 per pound.

Uses: The lead-acid battery industry continued to be the principal user of lead, accounting for about 86% of the reported U.S.[60] However, health and environmental issues associated with the metal have led to substitution with less hazardous materials, such as titanium or zinc in paints. Substitution of plastics has reduced the use of lead in cable covering, cans, and containers. Aluminum, iron, plastics, and tin compete with lead in other packaging and coatings. Tin has replaced lead in solder for new or replacement potable water systems. In the electronics industry, there has been a move towards lead-free solders with compositions of bismuth, copper, silver, and tin. Steel and zinc were common substitutes for lead in wheel weights.[61]

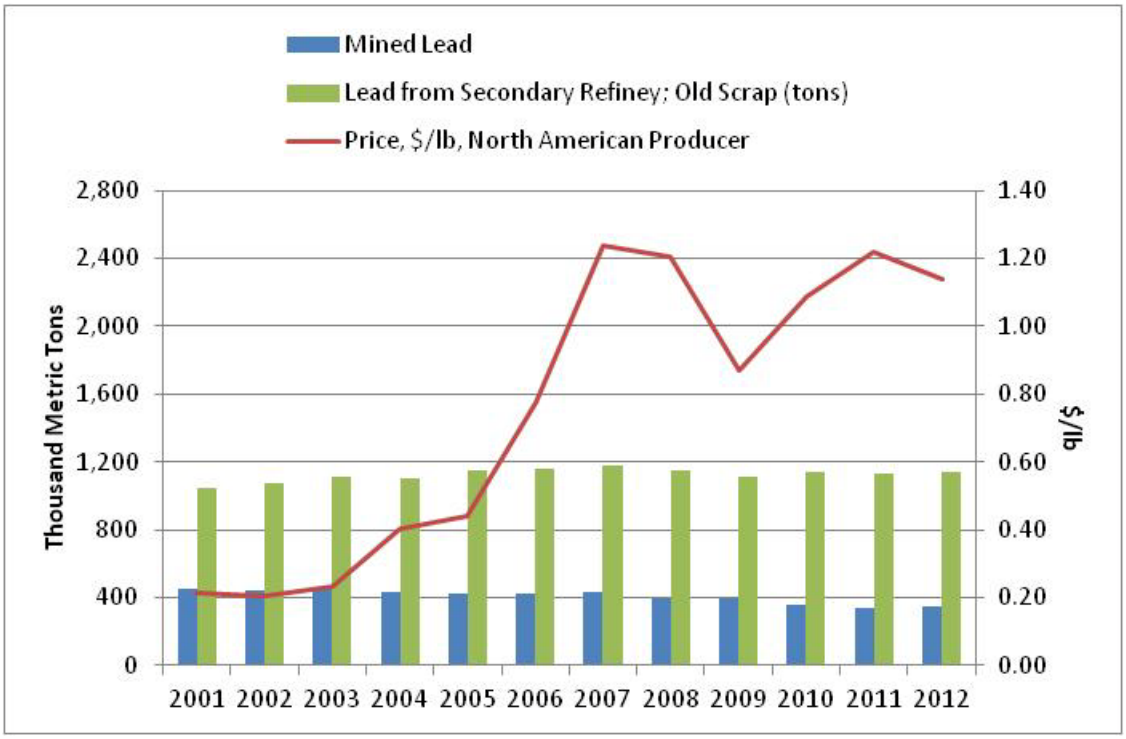

Figure 7-5. Lead Production and Prices

Source: USGS Mineral Commodity Summaries.

[60] U.S. Geological Survey, Mineral Commodity Summaries, January 2013.
[61] U.S. Geological Survey, Mineral Commodity Summaries, January 2013.

Economic Contributions and Economic Values

The estimated value added, economic contributions, and employment associated with non-fuel minerals mined on public and Indian lands in FY 2012 are summarized in Table 7-2.

While minerals are generally traded in competitive markets, market prices may not always incorporate the external costs associated with mining. These costs are primarily associated with the environmental impacts of mining. Environmental regulations (including financial guarantees, mitigation and reclamation requirements) may avoid, limit, control, or offset many of these potential impacts, but mining will, to some degree, always alter landscapes and environmental resources.

Market conditions affect the scope and nature of mining and the resulting external costs. For example, high prices tend to stimulate increased production from existing mines, and prospecting for new mines. Technological changes also affect the level and type of activities carried out, and all phases of mining have undergone substantial technological change over the last few decades. Exploration now uses remote-sensing techniques, improved conceptual models, new geochemical and geophysical instrumentation, statistical analyses and visualization of large data sets, and global positioning system capabilities, many of which were unknown two or three decades ago.[62] Some of these changes can assist in mitigating environmental impacts. Changes in market conditions also affect the demand and supply of minerals.

Table 7-2. Non-fuel Minerals - Value Added, Economic Contributions, and Employment Supported

Mineral type	Estimated Value Added	Estimated Economic Output	Estimated Employment Supported
	($ billions)		(number of jobs)
Non-locatable	3.04	4.97	25,795
Locatable	10.01	16.08	84,736

[62] National Research Council, 1999. *Hardrock Mining on Federal Lands.*

Chapter 8 Forage and Livestock Grazing

Introduction

The U.S. land area totals nearly 2.3 billion acres. Of this, grassland, pasture and range account for 614 million acres (27 percent).[63] Interior manages about one-third of this total (nearly 200 million acres) as public rangelands.[64] Public rangelands are important resources, particularly for the Western states, where most of the federal lands grazed by livestock are found, and where grazing has been an integral part of the landscape and lifestyle since the late 1800s. Public rangelands in the 17 Western states have a wide variety of climates, landforms, vegetation types, and social and economic settings.

Interior lands produced nearly 9 million animal unit months (AUMs) of forage. Prices for forage range widely, from $1.35 to $17 per AUM. Forage prices do not fully reflect changes to various ecosystem service values provided by rangelands. Forage production is associated with:

- $1.5 billion in output; and
- Supported 19,000 jobs.

This chapter focuses on rangelands managed by the Bureau of Land Management (BLM), though BIA manages rangelands as well.[65] BLM manages nearly 18,000 permits and leases held by ranchers who graze their livestock (mostly cattle and sheep) at least part of the year on more than 21,000 allotments. The permits and leases administered by the BLM generally cover a 10-year period and are renewable if the BLM determines that the terms and conditions of the expiring permit or lease are being met. While the number of Animal Unit Months (AUMs)[66] permitted by the BLM generally remains stable from year-to-year, the actual amount of grazing that takes place each year on BLM-managed lands can be affected by such factors as drought, wildfire, and market conditions.

Over the last 100 years the absolute numbers of livestock have increased in the West and the U.S. as a whole, in order to meet growing demands due to growth in the U.S. population. Over the same period, grazing on public lands has declined. A variety of other factors also have affected cattle numbers over time including: open range closures, which allowed some ranges to recover from the overuse in the late 1800s; publicly funded range improvements; the development of irrigation; increased and routine provision of supplemental feeds; greater attention devoted to breeding; and the ability to routinely shift livestock from public or private range land to feeder and finishing operations in other locations in the West and Midwest.

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[63] Osteen, Craig, Gottlieb, Jessica, and Vasavada, Utpal, editors. August 2012. *Agricultural Resources and Environmental Indicators*, 2012 Edition. United States Department of Agriculture Economic Research Service, Economic Information Bulletin Number 98.

[64] BLM manages 155 million acres for livestock grazing; BIA covers 46 million acres used for farming and grazing.

[65] Data on BIA grazing are available for Arizona, Nevada, New Mexico, and Wyoming, totaling 645,200 AUMs for FY 2012. This compares to BLM's 8.39 million AUMs across fifteen States.

[66] An AUM is the amount of forage needed to feed a cow, a horse or five sheep for one month. For example, 780 lbs of dry matter forage would sustain a 1,000 beef cow for one month.

Outputs

Grazing on BLM-administered lands decreased in the late 1950s and the late 1960s. During the 1990s about 9 million AUMs annually were billed; this has declined during the 2000s to about 8 million annually. Figure 8-2 shows the number of AUMs BLM permitted and billed annually from 1990 through 2011.[67] Figure 8-1 shows the downward trend in AUMs used, from 12.8 million in FY 1970 to less than 9 million in FY 2012.[68] The number of BLM grazing leases and permits has also declined from about 31,000 in 1949 to about 18,700 in 2011. No data are available on the extent to which permittees pasture livestock they do not own on their allotted AUMs.

Figure 8-1. BLM AUMs Used, 1970-2012

Source: BLM data.

[67] BLM does not systematically track "actual use" in its Rangeland Administration System (RAS). BLM does, however, track "billed use" systematically. Billed use can proxy for actual use, but information is not available to know for certain if all billed AUMs were used by the permittee or lessee.

[68] For Figure 8-1 and Figure 8-2 the BLM Montana State Office administers grazing permits/leases in North and South Dakota, so those permits are shown as part of Montana data. Similarly, Oregon administers permits/leases for the state of Washington which are included as part of Oregon data.

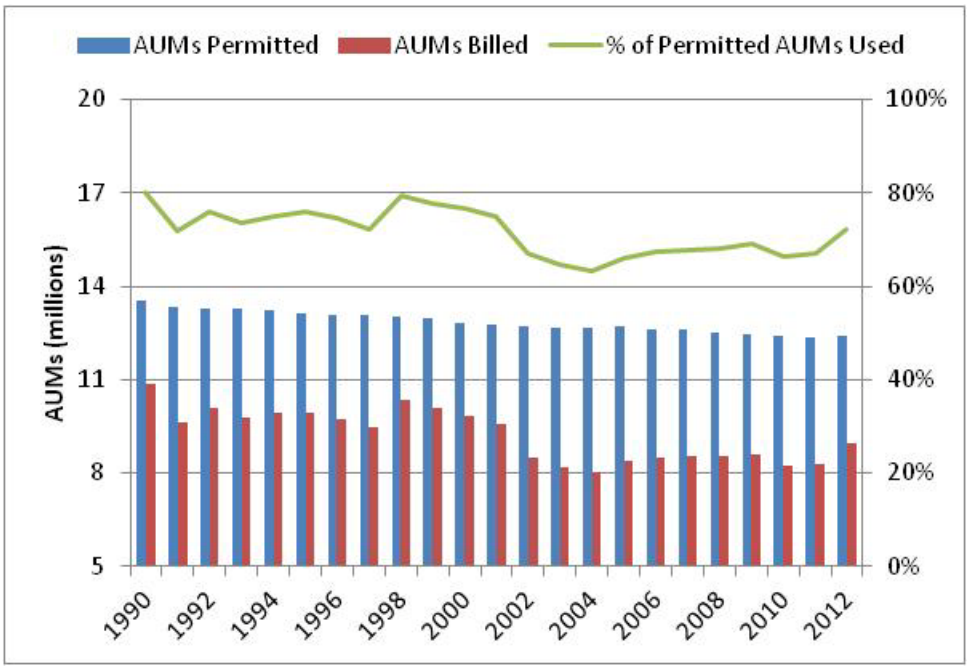

Figure 8-2. Permitted and Billed AUMs, 1990-2012

Source: BLM data.

Table 8-1 shows the BLM grazing fee over 1981 – 2012. A 1968 revision to the grazing fee schedule was based on a 1966 survey, which established a fair market value of $1.23 per AUM for 1966. The new schedule was put into effect gradually over the 1970s. The fee is adjusted annually for three factors based on costs in western states of (1) the rental charge for pasturing cattle on private rangelands, (2) the sales price of beef cattle, and (3) the cost of livestock production. Congress also established that the annual fee adjustment could not exceed 25% of the previous year's fee.

Table 8-1. BLM Grazing Fees, 1981-2012

Year	Nominal Fee per AUM	Inflation-Adjusted Fee per AUM (2012 $)
1981	$2.31	$5.83
1982	$1.86	$5.50
1987	$1.35	$4.67
1988	$1.54	$4.48
1989	$1.86	$4.28
1990	$1.81	$4.06
1991	$1.97	$3.89
1992	$1.92	$3.78
1993	$1.86	$3.67
1994	$1.98	$3.58
1995	$1.61	$3.48
1996	$1.35	$3.38
1997	$1.35	$3.30
1998	$1.35	$3.25
1999	$1.35	$3.18
2000	$1.35	$3.08
2001	$1.35	$2.99
2002	$1.43	$2.95
2003	$1.35	$2.88
2004	$1.43	$2.81
2005	$1.79	$2.72
2006	$1.56	$2.63
2007	$1.35	$2.56
2008	$1.35	$2.46
2009	$1.35	$2.47
2010	$1.35	$2.43
2011	$1.35	$2.36
2012	$1.35	$2.31

Source: *Grazing Fees: Overview and Issues*. Congressional Research Service. June 19, 2012; *Study of Fees for Grazing Livestock on Federal Lands*. 1977. DOI and USDA. Page 2-33. http://tinyurl.com/FedGrazing1977.
Nominal fees adjusted for inflation using the CPI-U.

Economic Contributions, and Economic Values

The primary input provided by public land is forage for cattle and sheep production. In FY 2012, under existing BLM permits and leases a maximum of 12.4 AUMs of grazing could have been authorized for use. Instead, about 9 million AUMs were used. The remaining AUMs were not used due to resource protection needs, forage depletion caused by drought or fire, and economic and other factors. Fees were collected for billed use at the federal grazing fee of $1.35/AUM. As shown in Figure 8-3, roughly

16% of the total BLM permitted or leased AUMs are in Nevada, with Wyoming and Idaho each having about 15%.

The forage on BLM-administered lands was estimated to support 17,000 jobs and nearly $1.5 billion in economic output in FY 2012. Estimates of value added are not available. Forage on tribal lands was estimated to provide $0.1 billion in economic output in FY 2012 and support about 1,400 jobs.

The forage provided by BLM managed lands is an important input in cattle and sheep production. For the 17 Western states, livestock receipts in 2012 totaled about $70 billion[69], representing 46 percent of all U.S. livestock receipts, and about 1 percent of the combined gross domestic product for these States. Cattle and calves, and sheep and lambs accounted for about $49 billion, or 69 percent of Western livestock receipts. Direct economic output attributable to public land forage for FY 2012 was estimated to be approximately $808 million dollars - or about 1.6% of cattle and calves and sheep and lamb receipts in the 17 Western states. At a state-level, the proportion of receipts attributable to public land forage varies substantially.

Multiple factors influence the levels of grazing BLM authorizes and the use made of permitted AUMs by permit holders. For example, physical factors such as range condition and forage availability play an important role in determining the AUMs available in any given year. Markets for outputs (livestock) and inputs (feed, fertilizer, gasoline) are also important, although market conditions are not solely responsible for the overall downward trend in federal AUMs purchased.

The market demand for forage for livestock grazing depends on cyclic cattle prices (livestock operations require several years to respond to sustained high or low price signals), the prices of other livestock species, the price of forage, the price of supplemental feed and the prices of alternative forage or feed sources, which vary regionally.

Table 8-2. Grazing Fees in 2010 on State Trust Lands

State	Grazing Fee ($/AUM)
Arizona	$2.28
California	no set fee
Colorado	35% below private rate
Idaho	$5.12
Montana	minimum $6.12
New Mexico	$3.19
Nevada	variable
Oregon	$5.30
Utah	$3.92-$7
Washington	$8.78
Wyoming	$4.64

Source: Montana Trust Land Grazing Lease Rate Valuation Analysis. 2011. State of Montana Department of Natural Resources & Conservation: Trust Management Division.

[69] Source: ERS Farm Income and Wealth Statistics for Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming (http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx).

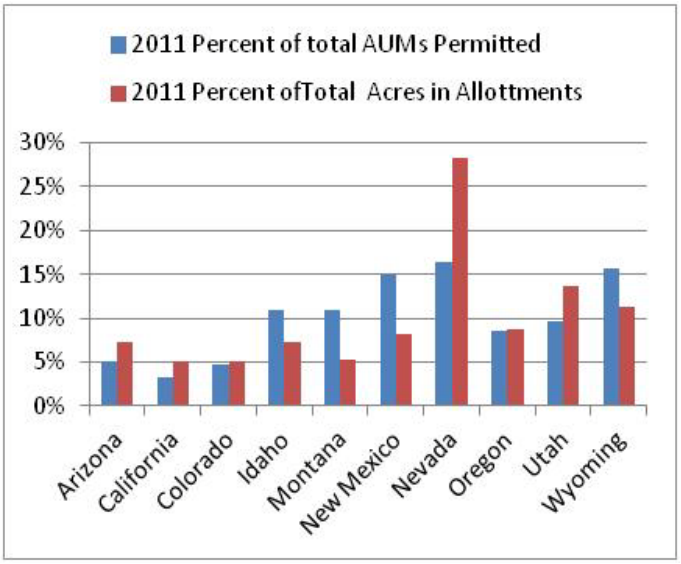

Figure 8-3. Acres Allotted and AUMs Permitted by State

In theory, thus the economic benefit to a rancher of an AUM depends on its productivity and on the costs and productivity of alternative feed sources. An AUM will be leased if the cost is less than the economic benefit a rancher expects the AUM to generate.[70] Public land grazing also carries substantial lifestyle benefits and "economic benefits" includes more than financial profit. Also the history and tradition of public land grazing may influence individuals' leasing/permitting decisions as much as the financial statement.

The federal grazing fee is currently $1.35 per AUM, having declined from $1.98 in 1994 due to falling beef prices and rising production costs. The BLM grazing fee has historically been a fraction of grazing fees for state lands, and has had little or no impact on the downward trend in the number of AUMs purchased over time. In general terms, grazing fees represent a small proportion (roughly 5%–10%) of total production costs.[71] Fees charged by the other federal agencies, as well as state land agencies and private ranchers, vary widely depending on the purpose for which the fees were established and the approach used to set the fees.[72]

The fact that BLM forage is often sold at rates lower than prevailing rates associated with alternative sources of forage also creates an incentive to use federal forage before using other forage sources and perhaps to use federal grazing allotments more intensively than privately owned rangeland.

[70] U.S. Department of the Interior, Bureau of Land Management. 1994. Rangeland Reform '94 Draft Environmental Impact Statement.
[71] Short, Sara D. November 2001. *Characteristics and Production Costs of U.S. Cow-Calf Operations*. USDA Economic Research Service Statistical Bulletin Number 974-3; Rimby, N. and Torell, A. March 22, 2011. *Grazing Costs: What's the Current Situation?* University of Idaho Agricultural Economics Extension Series No. 2011-02.
[72] U.S. Government Accountability Office. 2005. Livestock Grazing Federal Expenditures and Receipts Vary, Depending on the Agency and the Purpose of the Fee Charged. GAO-05-869.

In FY 2011, the average market price of forage was $16.80/AUM on private land in the 11 Western states,[73] a 15% increase from about $14.60/AUM in 2006.[74] This value is substantially higher than the FY 2012 average federal grazing fee of $1.35/AUM. However, differences between the costs of grazing private leases and the costs of grazing public leases should also be recognized. For example, private landlords may provide additional services like fencing, water infrastructure, secure access, check-up visits, and rights to hunt, fish and timber the area. LaFrance (1995) estimated that these services could account for about 30% of the fee. LaFrance estimated that the value for forage alone (net of costs of providing that forage) averaged $12.85 to $14.89 (2012 dollars) for the eleven Western States in 1992. In addition, due to the larger geographical extent of public lands ranchers experience higher costs associated with herding, lost animals, and travel. Some research has shown that when these factors are taken into account, the costs of grazing on public and private land in New Mexico, Wyoming, and Idaho are similar (Rimbey and Torell, 2011). Disputes about the extent to which federal grazing fees reflect "fair market value" persist. The extent to which BLM grazing fees are below comparable state or private fees differs by region. Table 8-2 shows the grazing fee in 2010 for state trust lands.

References

LaFrance, J. T. and M. J. Watts. 1995. "Public Grazing in the West and 'Rangeland Reform '94'." *American Journal of Agricultural Economics* 77: 447-461.

Rimbey, N., and L.A. Torell. 2011. "Grazing Costs: What's the Current Situation?" Agricultural Economics Extension Series No 2011-02.

[73] Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
[74] USDA NASS, 2012 Federal Grazing Fee, 1/26/12. A head month is a month's use and occupancy of range by one animal, except sheep and goats. Compare to an AUM, based on a standard "animal unit" of a 1,000-lb cow.

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Chapter 9 Timber

Introduction

In FY 2012, about 541,000 mbf of timber was harvested on BLM and tribal lands. This timber harvest was associated with:

- $554 million in value added,
- provided $1.4 billion in output,
- and supported 7,000 jobs.

Market prices do not fully reflect changes to various ecosystem service values provided by forest lands.

The United States has about 751 million acres of forest land, with 623 million acres in the conterminous United States. Forest land in the United States is widely but unevenly distributed, and varies from sparse scrub forest of the arid Interior West to highly productive forests along the Pacific Coast and in the South, and from pure hardwood forests to multispecies mixtures and coniferous forest. Almost two-thirds (514 million acres) of the Nation's forests are classified as timber lands, the primary source of wood production; 72 percent of these are in the East. About 75 million acres of forest are reserved for non-timber uses under the management of public agencies. The remaining 162 million acres do not qualify as timber land, but are important for watershed protection, wildlife habitat, grazing, and recreation. About 87 percent of these acres are found in the Interior West and interior Alaska. [75]

The U.S. forest land base has remained relatively stable for almost 100 years, despite population growth. USDA expects the continuing need to accommodate a growing population will result in reduced forest area in the future, however, largely as a result of urbanization and other land development. Forest land losses are projected to range from 16 to 34 million acres in the conterminous United States. The South Region is expected to have the greatest loss of forest, ranging from 9 to 21 million acres between 2010 and 2060, roughly 4 to 8 percent of the region's 2007 forest land base.[76]

Historically, the volume of roundwood needed to make wood and paper products consumed in the United States (including product imports) grew at roughly the rate of population growth. Per capita consumption has declined with the downturn in housing construction since 2005. The weakening of the U.S. dollar and productivity gains by U.S. producers have lowered the import share of U.S. wood and paper product consumption and increased the export share of production, making the U.S. a net exporter of wood pulp, paper, and paperboard for the first time in many decades.[77]

During the past 50 years, the North American forest sector has undergone rapid labor-saving technology changes. These changes occurred also in other parts of the economy, as capital intensification reduced the demand for workers throughout a shrinking manufacturing sector, especially in the United States.

[75] USDA Forest Service. 2012. Future of America's Forest and Rangelands: Forest Service 2010 Resources Planning Act Assessment. Gen. Tech. Rep. WO-87. Washington, DC.
[76] Includes all forested lands (federal, state, and private).USDA Forest Service. 2012. Future of America's Forest and Rangelands: Forest Service 2010 Resources Planning Act Assessment. Gen. Tech. Rep. WO-87. Washington, DC.
[77]USDA Forest Service. 2012. Future of America's Forest and Rangelands: Forest Service 2010 Resources Planning Act Assessment. Gen. Tech. Rep. WO-87. Washington, DC.

The result for the forest sector was static or falling employment levels in lumber, wood, paper, and other products.

North American lumber prices have increased over the past several years. The price of Douglas fir has risen from about $250 per MBF in January 2011 to about $300 per MBF in the summer of 2012. Figure 9-1 shows the price trend for some key softwoods over 1990-2011.

Real price trends indicate that pulpwood has become relatively more abundant in the United States since the late 1990s, a result of increasing supplies (continued timber growth and maturation of pulpwood plantations, and other recent investments in plantation intensity), a general declining trend in consumption, and efficiency gains in timber harvesting and conversion technology.

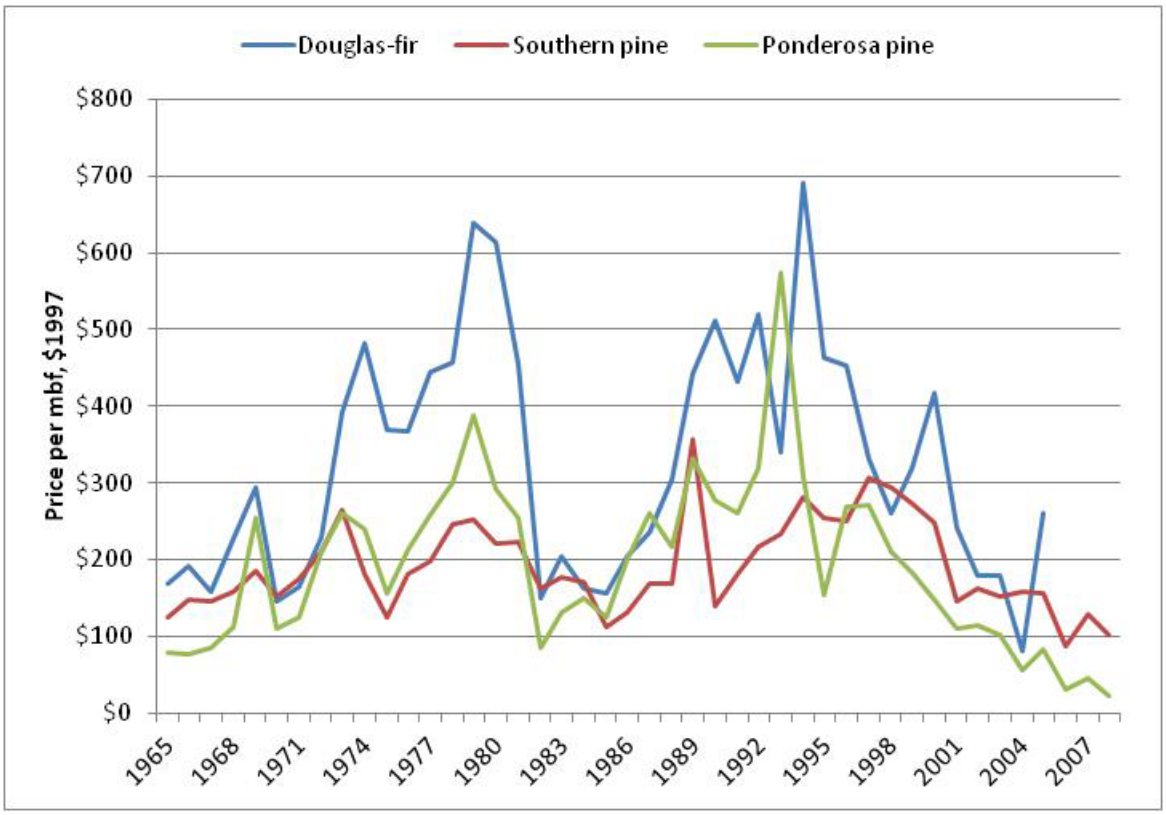

Figure 9-1. Stumpage Prices per Thousand Board Feet ($1997)

Source: USDA data. Real prices in $1997. Douglas fir data not available beyond 2005.

Forests and woodlands make up one fourth of the lands managed by the BLM, or about 67 million acres. Of these, 11 million acres are commercial forestlands, generally with species used for products such as lumber, plywood, and paper. Fifty five million acres are woodlands, of which 11 million acres overlap with rangeland sites. These BLM lands are mostly piñon/juniper, western juniper and aspen and provide high quality wildlife habitat. Woodlands produce fuelwood, posts, poles, greenery and biomass for energy production to local communities. BLM's forests and woodlands are comprised of the Oregon and California (O&C) lands in western Oregon (2.3 million acres), and the public domain lands scattered across the 13 Western states (32 million acres) and Alaska (33 million acres). The O&C Act (Public Law 75-405) requires that the O&C lands be managed to provide a permanent source of timber supply,

protect watersheds, regulate stream flow, contribute to the economic stability of local communities and industries, and provide recreational opportunities.[78]

The BLM has traditionally placed its forested lands into one of two broad categories: Commercial Forest and Woodland. Commercial Forest Lands (also referred to as timberlands) were forest types that typically provided commercial processed wood products (lumber, plywood, paper, etc.) and were often considered the lands with the most potential for management. Woodlands were forest types that typically did not provide commercial wood products.

In the lower 48 states, BLM forest lands consist of tree species with a tall-stature growth, such as Douglas-fir, ponderosa pine, and lodgepole pine, and total about 4.6 million acres (or about 8% of BLM forested lands). Woodlands consist of tree species dominated with a low-stature, multiple-stem growth form and include pinyon pines, junipers, and many western oaks and total about 28 million acres. An additional 25 million acres are in Alaska, which occur in large, inaccessible expanses with very little market demand.

BLM data indicates that there is an estimated 150 million CF of annual mortality on BLM forested lands, predominately in the inland western states, due to insects and disease and wildfire. This mortality estimate may be an underestimate, but still equates to over 4 times greater than BLM's harvest volumes, and reflects the extent of the problems of wildlife and insects and disease.[79]

Native American reservations contained 6.1 million acres of unreserved, accessible, commercial timberland as of September 30, 2012.[80]

Outputs, Economic Contributions, and Economic Values

Eight percent of BLM's forest land is classified as timberland. As of December 2010, there were about 15.5 billion cubic feet of standing inventory, which is equivalent to about 308 million tons. This timber is equivalent to about 396.5 million cubic feet of industrial output, or 0.8 million tons. Industrial output as percentage of inventory is 2%.[81]

BLM offered 242,000 thousand board feet (MBF) for sale in 2012. This compares to 240,000 MBF offered for sale in 2011. BLM has offered an average of about 250,000 MBF per year over 2005-2012. About 90% of the timber offered by BLM is from the O&C lands. About 333,209 MBF of timber, with a total value of $35.1 million, was sold on tribal lands in FY 2012. About 70% of the timber value came from BIA's Northwest region; 21% came from the Midwest region.

[78] See http://www.blm.gov/wo/st/en/prog/more/forests_and_woodland.html.
[79] The definition of commercial forest land (timberland) and woodland now include species such as aspen, pinyon pine, and juniper; also widespread wildfire activity has increased emphasis on vegetation treatments to reduce fuel loads regardless of the forest type. With the higher interest in forest health and fuels management there is more urgency for management in woodland areas. Source: BLM internal data.
[80] "Unreserved" is forest land that is administratively available for harvest; "accessible" is forest land that is physically, administratively and economically accessible to harvest or is anticipated to become so during the management plan period. Source: FY2012: Quarter 4 Catalog Of Forest Acres Compiled by: USDI, Bureau of Indian Affairs Division of Forestry Branch of Forest Resources Planning September 30, 2012.
[81] Source: BLM internal data.

Figure 9-2 shows BLM sawtimber harvest volumes and average prices per MBF over 2005-2012. Annual harvests have varied little since 2005, remaining in the range of 150,000 to 200,000 MBF. The average price has ranged from about $202 per MBF in 2007 to about $93 per MBF in 1993. Figure 9-3 shows timber volumes and price for timber harvested from tribal lands. Since 2007, the downward harvest trend on tribal lands is attributed to the closure of three large tribal sawmills (likely related to the economic slowdown).

Figure 9-2. BLM Timber Harvest and Average Prices, FY 2005-2012

Source: BLM data.

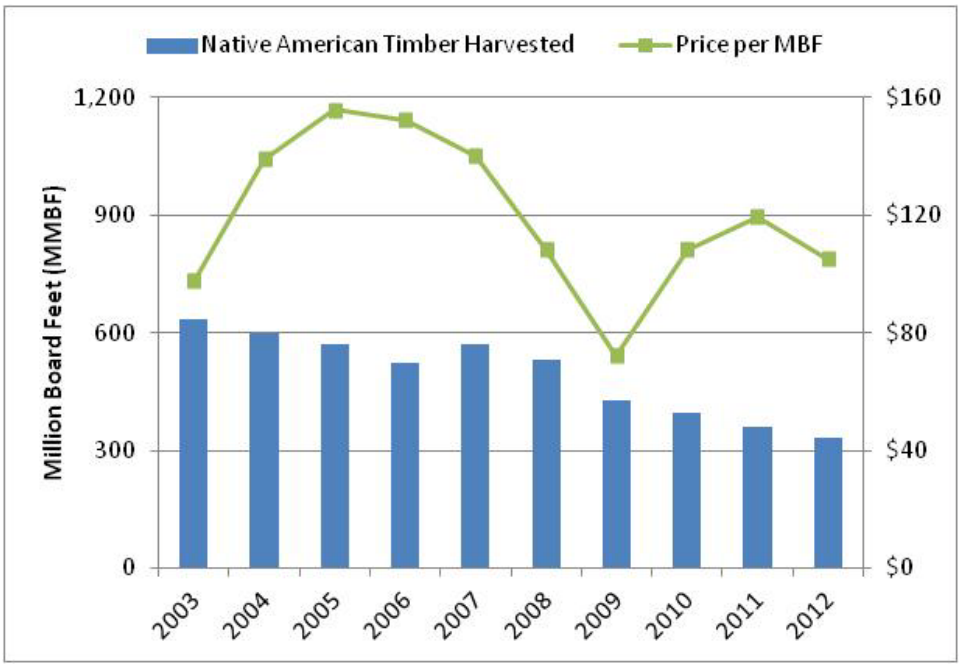

Figure 9-3. Native American Timber Harvests and Prices

Source: BLM data.

BLM timber is sold on a competitive basis and the prices received reflect market values.[82] The average value of BLM sawtimber harvested in FY 2012 was $120 per MBF. This compares to $93 per MBF in 2011. The average value of timber harvested on tribal lands was $105 per MBF. There is considerable variation across regions, with values in the Pacific Region exceeding $200 per MBF. Economic contributions from timber are as follows:

- Timber produced from BLM lands supported over 3,000 jobs, nearly $267 million in value added and about $690 million in economic activity in 2012.[83]
- Timber produced from Native American timberlands is estimated to have supported over 4,000 jobs, nearly $287 million in value added, and over $719 million in economic activity in 2012.

[82] As noted previously, market prices do not reflect changes to various ecosystem service values provided by forest lands. These services include supporting water quality and quantity, nutrient cycling, recreation, and climate regulation. Quantifying the value of non-market services associated with forest ecosystems is difficult.

[83] Estimates reflect economic contribution from commercial sales of timber, primarily wood-based products including sawtimber, posts, poles, commercial fuelwood, and biomass. The BLM's forestry and woodlands management program manages public access to a variety of other forestry products including personal use fuelwood and non-wood Special Forest Products (such as Christmas trees, native seeds, mushrooms, and floral/greenery). Non-wood Special Forest Products from BLM-managed lands generated approximately $250,000 in sales in FY12.

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Chapter 10 Mitigation, Reclamation, Restoration and Recovery

Introduction

The U.S. Department of the Interior (DOI or Interior) extensively supports—through its mission, policy, programs, and funding—the study, planning, implementation, and monitoring of ecosystem restoration. As described in Chapter 4 of the FY 2011 DOI Economic Contributions Report, every bureau and several offices in Interior engage in some form of restoration, including ecological, human use, or physical structures. This chapter focuses on four programs that represent the full range of mitigation, reclamation, restoration and recovery activities at Interior: (1) the Bureau of Land Management's (BLM) Abandoned Mine Lands Program, (2) natural resource damage assessment and restoration (NRDAR) implemented through the DOI Restoration Program, (3) the U.S. Fish and Wildlife Service's (Service or USFWS) Environmental Contaminants Program, and (4) remediation and environmental restoration of DOI contaminated sites funded through the Department's Central Hazardous Materials Fund (CHF) Program. Highlights of ongoing efforts to estimate economic values and economic contributions associated with restoration activities are also provided.

Urban Restoration: Watts Branch

The Anacostia Watershed lies within the Chesapeake Bay drainage basin, and is one of the most urban watersheds within the basin. Restoration efforts were focused on a highly polluted 1.8 mile stretch of Watts Branch, a tributary of the Anacostia. The project was a collaborative effort between DOI, USDA, EPA and other non federal entities. Total restoration project costs were over $3 million (2011$). The local economy surrounding the project location includes 20 counties in Virginia, West Virginia, and Maryland within commuting distance of the D. C. metropolitan area. Due to the urban nature of this project and the wide local availability of materials, much of the money spent stayed within the local economy. In total, USGS estimated that restoring Watts Branch supported 45 jobs, $2.6 million in labor income (salaries, wages, and benefits), and $3.4 million in valued added (the contribution of expenditures to Gross Domestic Product). For additional details, see: *Restoring a Stream, Restoring a Community— Urban watershed restoration fosters community improvement* (http://pubs.er.usgs.gov/publication/70045790).

Background

Activities intended to improve injured ecosystems may be referred to as "restoration," "rehabilitation," "remediation," "reclamation," etc. These terms are often used interchangeably in practice, but their definitions vary by authorizing and implementing agencies.

For purposes of this chapter, ecosystem (or ecological) restoration is defined as an intentional activity that initiates or accelerates the recovery of a degraded, damaged, or destroyed ecosystem (both floral and faunal organisms) with respect to its health, integrity, services, and sustainability (SERI 2004). Ecosystem health provides a useful metaphor for human health, and helps emphasize that most of DOI's

lands and managed resources play an integral role in the welfare of many Americans and most of these resources have been altered by people. For example, chemicals or oil may be present and need to be addressed prior to restoration through removal, cleanup, or remediation of the land. Some ecosystems may have been changed so dramatically that a return to the original landscape is no longer possible and rehabilitation or on-site mitigation—a partial return to a previous state—could be the only option. Reclamation is the process of reconverting disturbed land to its former or other productive uses. It is commonly used in the context of mined lands. Reclamation projects that are more ecologically based can qualify as rehabilitation or even restoration.[84] Off-site mitigation is an action intended to compensate for environmental damage. Regardless of approach, monitoring is needed to ensure the desired goals are actually achieved. A resource is considered recovered when it can sustain itself structurally and functionally.

Outputs

The primary measures of mitigation, reclamation, restoration and recovery success have been physical—numbers of acres, stream/shoreline-miles, and sites; and percent recovery of species—as described below. It is widely recognized that these types of program outputs are important for understanding and conveying restoration success, but they do not fully reflect the outcomes of restoration investment. Interior's lands and managed resources produce a wide range of valuable ecosystem services, including agriculture, drinking water, energy, flood and disease control, carbon sequestration, recreation, and cultural resources. Interior's ecosystem restoration activities play an important role in maintaining and enhancing the services from departmental lands and managed resources. Although the jobs and economic contributions from restoration are substantial and important, they do not represent the full economic value of ecosystem restoration because they do not capture the net benefits associated with environmental goods and services not bought and sold in markets. Restoration, reclamation, rehabilitation, and remediation activities are often very costly. A fundamental question for most decision makers is whether the total benefits exceed the total costs (i.e., generates positive net benefits). While investment in these projects provides value to the public by restoring ecosystem function and structure to damaged, degraded, and destroyed ecosystems, they are often non-market benefits. If proper economic analysis is not conducted, an incomplete measure of these benefits could lead to under-investment in restoration or selection of a project option with lower actual net benefits than other alternatives. Challenges remain to develop metrics to quantify and value restoration outcomes.

BLM's Abandoned Mine Lands (AML) Program

The AML Program enhances public safety and improves water quality by reducing or eliminating the effects of past mining (primarily hardrock) in the western United States. Spatially, the program deals with contaminated sites and specific features on these sites. Features include open physical hazards and piles of contaminated material. The program seeks to apply the "polluter pays" principle to achieve cost recovery/cost avoidance for funding AML projects wherever possible. The ultimate goal is to reclaim AML to productive uses including, but not limited to, recreation, fish and wildlife habitat, and preservation of historical and cultural resources. BLM maintains an inventory of known AML on public

[84] See Stahl, P.D., *et al.,* 2006, for more discussion on reclamation and ecosystem restoration.

lands. In some cases, data or historical records—such as those from the former Bureau of Mines—were available to support quick validation of the location and status of past mines. In other cases, though, the locations of these historic mines were not well documented and accurately determining their locations and status involves additional effort. BLM is continuing to work with its partners to locate and evaluate these remaining historic mines, and to prioritize their restoration and protection. BLM and its partners are also working on sharing and displaying AML spatial data within a National Mine Land Inventory at www.geocommunicator.gov.

As shown in Figure 10-1, as of January 2013, the BLM database includes 38,982 AML sites in a variety of remedial and restoration stages.

Table 10-1 provides a 6-year overview of the AML inventory and activities, showing an increase in both funding and site inventories. According to BLM, their ability to identify additional sites was supported by additional funding made available to the AML program. The funding increase supported efficiency improvements and innovative management initiatives. Such improvements included establishing inventory teams and field validation studies to improve the completeness of the inventory and enhance data quality.

FY2012-FY2013: USGS Assessment of Ecosystem Service Values for the Central Everglades Planning Project

Economists at USGS, in collaboration with the University of Florida, U.S. Army Corps of Engineers (USACE), and other federal and state agencies, are conducting an interdisciplinary assessment of the value of ecosystem services that will be affected by restoration activities in Florida's central Everglades. The team will monetize the value of select ecosystem services using existing data and benefit transfer methods, and provide a qualitative description of those services that lack existing data or will not be significantly impacted by restoration activities. This effort will highlight gaps in the existing literature to efficiently guide future ecosystem service valuation research in the central Everglades. This ecosystem services assessment is unique in that it will result in an estimate of the future value of a restored ecosystem, significant for the Comprehensive Everglades Restoration Plan and its stakeholders, the general public, USACE Jacksonville District, and USACE nationally. The results will also be relevant to others who may want to use ecosystem services valuation as a means of choosing among restoration options.

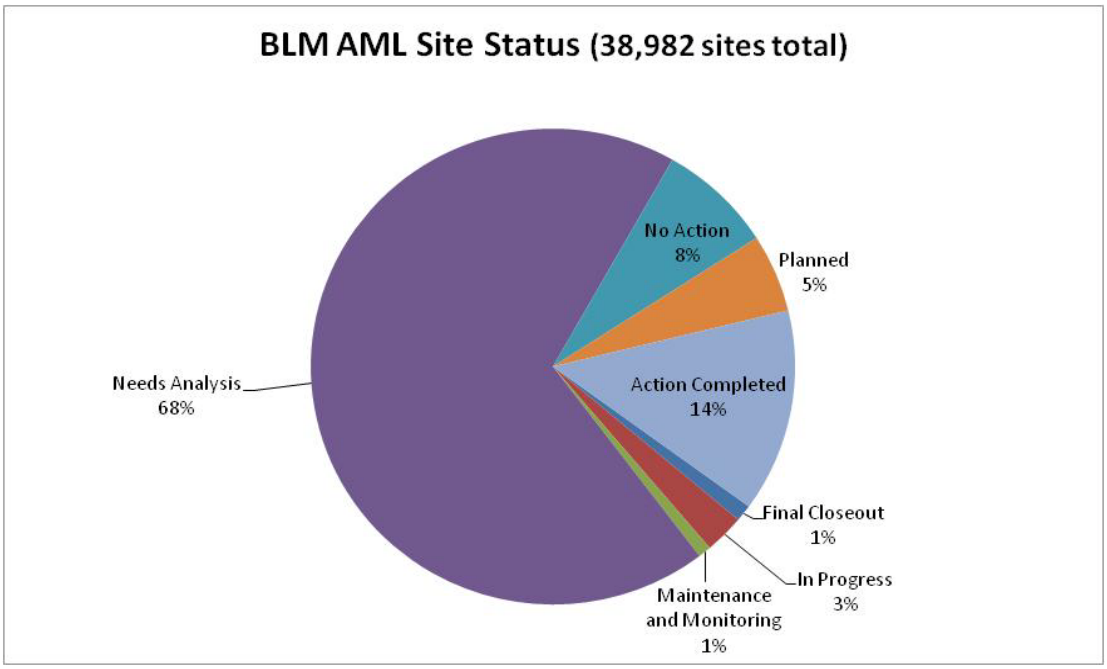

Figure 10-1. BLM AML Site Status (as of January 10, 2013)

Source: BLM data

Table 10-1. BLM's FY 2006-2011 Abandoned Mine Land Accomplishments-at-a-Glance

Inventory Status	FY 2006-2008*	FY 2009-2011
BLM AML Funding	$27 million	$77 million
AML inventory of known sites on public lands	16,000 sites	28,000 sites
Number of AML sites discovered, evaluated, prioritized for funding	3,487 sites	11,840 sites
# Restored AML sites	1,288 sites	3,143 sites
# Acres AML restored	4,137 acres	4411 acres
# Acres of AML addressed to restore water quality	≈1,470 acres	≈1,600 acres
# Restored AML sites monitored and maintained	949 sites	2,070 sites

*BLM baseline for future accomplishments reporting.
Source: BLM, *Abandoned Mine Lands: A New Legacy*, December 2012.

The Office of Restoration and Damage Assessment (ORDA) and the DOI Restoration Program

Under the authorities of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (also known as CERCLA or "Superfund"), the Clean Water Act, and the Oil Pollution Act of 1990, federal, state, and tribal trustees seek to identify and restore natural resources injured from hazardous substances or oil through the DOI Restoration Program. The program is administered by ORDA and comprised of staff from BIA, BLM, USFWS, National Park Service (NPS), Reclamation, Solicitor's Office, U.S. Geological Survey (USGS), and the Office of Policy Analysis. The Department's trust resources include national parks, national wildlife refuges, lands managed by BLM, Indian lands, and natural resources held in trust by the federal government, waters managed by Reclamation, and federally-protected migratory birds and endangered and threatened plants and animals. The Restoration Program ensures the responsible parties, not taxpayers, bear the cost of restoring these injured resources to the quality and level of services provided had the event not occurred. Table 10-2 provides a 5-year overview of Restoration Program performance. As shown in Table 10-4, FWS had 277 NRDAR cases in progress in FY 2012. With ORDA's support, staff at the USGS Environmental Research Center in Columbia, Missouri, are actively working to develop ecosystem services metrics to better measure the ecological outcomes of restoration activities.

CHF and America's Great Outdoors: Anacostia Riverwalk Trail in Washington, DC

In FY 2012, the CHF funded 18 projects in BLM, 14 projects within USFWS, and 17 in NPS, along with others in the Bureau of Indian Affairs and USGS. Many of these contaminated areas indirectly impact tourism and recreation in the local areas, and in some instances recreational opportunities for the public are dependent on a site's cleanup. Six CHF funded sites are near, or impact the completion of America's Great Outdoors Projects. One example is the Anacostia Riverwalk Trail in Washington, DC. Once the trail is completed, it will cross three NPS CHF projects (Kenilworth Landfill, Poplar Point, and Washington Gas and Light). The final segments of the trail will be constructed once the cleanup has been completed. The trail will provide residents and visitors opportunities for connection to the Anacostia River, along with commercial and recreational destinations.

FWS Environmental Contaminants (EC) Program

The EC Program is dedicated to protecting fish, wildlife and their habitats from the harmful effects of pollutants, climate-related ecological changes, and the interactions between the two. The EC staff work in three important areas: (1) identifying and assessing the effects on species and habitats exposed to contaminants; (2) preventing trust resources from being exposed to hazardous levels of contaminants; and (3) restoring habitats and DOI trust resources injured by contaminants. Table 10-4 provides a 5-year overview of select activities conducted by EC staff.

Central Hazardous Materials Fund Program

Established in 1995, the Central Hazardous Materials Fund (CHF) is a significant source of funding for the cleanup of the most highly contaminated sites located within national parks, national wildlife refuges,

and other DOI-managed lands. These sites typically pose potential risks to employees, public health and welfare, and the environment. This effort integrates Interior's interests in remediation and environmental restoration of the contaminated sites it manages into CERCLA response actions. The CHF Program cost-effectively leverages DOI's legal, technical, and project management expertise to address the highest priority cleanup sites, which are typically so costly and complex to clean up that they cannot adequately be addressed using available bureau resources. CHF sites range from AMLs to landfills and former industrial facilities. Some of the larger sites include the Crab Orchard National Wildlife Refuge, Illinois; Valley Forge National Historic Park, Pennsylvania; Red Devil Mine, Alaska; Phosphate Mines, Idaho; and Orphan Mine, Grand Canyon National Park, Arizona. In 2012, the following types of sites were provided new funding: AMLs, prior industrial facilities, prior utility sites, landfills, firing ranges, and a former in-holding that was contaminated with hazardous waste. Table 10-3 provides an overview of CHF Program activities.

Table 10-2. Resources Restored, Enhanced and Protected by the DOI Restoration Program

Performance Goal	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
# acres restored or enhanced	13,403	15,462	24,914	41,183	68,834	87,709	97,813
# stream-miles or shoreline miles restored or enhanced	42	171	391	186	377	401	409

Source: DOI Office of Restoration and Damage Assessment, May 2013.

Table 10-3. CHF Program Activities

Activity	FY 1995-2012*
CHF funding	$175 million
Recoveries from potentially responsible parties (PRPs)	$65.4 million
In-kind work	≈$250 million
# contaminated sites	65
# sites with cleanup complete	20

*CHF baseline for future accomplishments reporting.

Source: Office of Environmental Policy and Compliance, March 3013.

Table 10-4. FWS Environmental Contaminants Program Activities

Activity	Performance Goal	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Investigation/ Assessment	# contaminant actions benefiting FWS lands	N/A	N/A	1,764	1,006	1,755
	# of NRDAR cases in progress	277	258	267	TBA	277
Restoration*	Number of non-DOI riparian (stream/ shoreline) miles restored, including through partnerships, as specified in plans or agreements that involve DOI	9,796	11,054	3,334	891	1,748
	Number of non-FWS upland acres restored, including acres restored through partnerships, as specified in plans or agreements that involve FWS	384,960	271,138	240,345	191,288	166,718
	Number of non-FWS wetland acres restored, including acres restored through partnerships, as specified in management plans or agreements that involve FWS	974,658	458,713	363,141	372,004	235,537
Recovery	Percent of populations of native aquatic non-T&E species managed or influenced by the Fisheries Program for which current status and trend is known	40% (592/1,472)	34% (526/1,569)	32% (502/1,708)	34% (542/1,723)	35% (578/1,632)
	Percent of all migratory bird species that are at healthy and sustainable levels	62.3% (568/912)	62.3% (568/912)	72.0% (725/1,007)	72.1% (726/1,007)	72.1% (726/1,007)

*FWS NRDAR restoration activities are reported under the DOI Restoration Program
Source: FWS Environmental Contaminants Program, May 2013.

Economic Contributions and Economic Values

There is limited information available about the connection between expenditures and associated economic impacts of restoration projects, and even less information on economic values. Although several studies have addressed economic impacts of specific restoration projects, these estimates are not easily generalized to other restoration projects. The most comprehensive study of the economic impacts of restoration was conducted by the University of Oregon (Nielsen-Pincus & Moseley, 2010). This study specifically addressed forest and watershed restoration projects in the state of Oregon, and provides reliable and transferable estimates, but only for forest and watershed restoration projects in the Northwest.

Starting in FY 2011, ORDA and BLM have been supporting a research effort by USGS and Office of Policy Analysis to collect and analyze data for a broad range of restoration activities across the nation in order to develop better information on the economic impacts associated with restoration. For the FY 2011 DOI Economic Contributions Report, USGS quantified expenditures and economic impacts for nine restoration projects supported by DOI bureaus and partners. The results from these case studies confirmed that there is a large amount of variation in the economic impacts supported by restoration investments. Specifically, this preliminary work suggested that the type of restoration and the costs and availability of inputs and labor play a large role in impact estimates. Because of this substantial variation, it has become clear that applying generic economic impact multipliers from studies that estimate impacts of non-similar restoration projects is likely to result in large errors.

The nine case studies (available on-line at http://www.doi.gov/ppa/upload/Chapter-4.pdf) represent only a small subset of the broad range of restoration projects supported by DOI. In work planned for FY 2013, USGS anticipates surveying federal restoration case managers and supporting contractors to obtain additional information on the actual costs of various restoration activities, along with an improved understanding of the relationship between restoration investments, job creation, and economic impacts.

Chapter 11 Tribal Economies

Introduction

Interior has a unique responsibility to American Indians and Alaska Natives, as provided by the US Constitution, treaties, Supreme Court decisions and Federal statutes. The U.S. has a fiduciary responsibility to 566 Federally recognized Indian tribes. These tribes are sovereign nations, operating on a government-to-government basis with the U.S. government. Interior's support for tribal governments represents an important mechanism to facilitate the government-to-government relationship, advance economic development, improve Indian education, and improve the safety of Indian communities.

Interior supports tribal governments by facilitating economic development, ensuring and improving safety in Indian communities, and advancing Indian education. The economic values associated with these activities are significant, though difficult to measure. A large part of Interior's efforts occur in the form of financial support to Tribal governments, for which contribution estimates are readily available.

- Value added: $14.4B;
- Economic contribution: $17.5B;
- Employment supported: 94,000.

The Office of the Assistant Secretary-Indian Affairs (AS-IA) includes two bureaus, the Bureau of Indian Affairs (BIA) and the Bureau of Indian Education (BIE). BIA and BIE provide services directly or through contracts, grants, or compacts to a service population of 1.7 million American Indians and Alaska Natives who are members of the Federally recognized Indian tribes.

The BIA's mission is to fulfill the Federal government's Indian trust responsibilities and to promote tribal self-governance. The BIE's mission is to provide quality educational opportunities in accordance with a tribe's needs for cultural and economic well-being. Through these missions, BIA and BIE contribute substantially to economic growth in tribal areas through advances in infrastructure, strategic planning, improved practices of governance, and the development of human capital. In addition, several other offices exist within AS-IA, including administrative offices (the Office of the Chief Financial Officer and the Office of Human Capital Management) and program-based offices: Federal Acknowledgement; Homeland Security and Emergency Management; Indian Energy and Economic Development (IEED); Indian Gaming; Regulatory Affairs and Collaborative Action; and Self-Governance. These offices all play an important role in promoting tribal economic development. The IEED engages with tribes in numerous activities that have direct and indirect impacts on the nation's GDP and employment. Many of these activities are managed directly by tribes through P.L. 93-638 tribal agreements, which support the policy of self-determination, enabling tribes to administer projects independently.

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Outputs, Economic Contributions, and Economic Values

Economic information and statistics play an important role in economic development activities because such information can help inform program and policy development. During FY 2012, Indian Affairs made initial efforts to improve the economic statistics collected for American Indians and Alaska Natives in Federally recognized tribes. These efforts included establishing an interagency working group (the Secretary's Office, the White House Domestic Policy Council, the Bureau of Labor Statistics, the Bureau of the Census, and the Office of Management and Budget) and conducting preliminary discussions with the Bureau of the Census regarding existing data they collect on Indians. Consultations with tribal leaders were also conducted on the availability of data that tribes have and on the data collected by the Bureau of the Census. It is anticipated that improving the quality and quantity of statistics collected will be a long-term effort, involving a number of federal agencies. The general absence of official economic statistics on Indian Nations as part of the statistical measurement of the U.S. Economy creates challenges in quantifying, and recognizing, the contribution of Indian Nations to the economy.

Economic contributions were estimated for the following programs: energy, minerals, forestry, and irrigation, as well as grants to support tribal governments and loan guarantees to Indian-owned businesses. Sufficient information was not available to develop comprehensive estimates for GDP and employment contributions for all IA activities. Some of the activities for which estimates could not be developed include construction (schools, roads, and other facilities), job training, support for the development of mineral materials activities, and hydropower production.

IA's efforts in FY 2012 contributed over $14 billion in value added, $18 billion in economic activity and support nearly 93,000 jobs, many of them on Indian lands. A summary is provided in Table 11-1. In particular:

- Oil, gas, and coal: These activities were associated with an estimated $13 billion in value added, $14 billion in output, and 67,500 jobs.
- Other minerals: a large part of the mineral production supported by IA comes from construction aggregate, including crushed rock, as well as sand and gravel, with BIA issuing business permits for sand and gravel production. Permit data is not readily available. However, analysis of mineral data from the Office of Natural Resources Revenue (ONRR) on "sand and gravel" operations where a lease was issued indicates that activities associated with those minerals provided $140 million in value added, $190 million in economic contributions, and supported 1,200 jobs.
- Irrigated agriculture: these activities were associated with an estimated $0.5 billion in value added, $1.1 billion in output, and 10,000 jobs.
- Timber: The value added and output value associated with timber on Native American lands are estimated at $287 million and $720 million, respectively. Employment supported is estimated at 4,000.

- Guaranteed Loans: Loan guarantee programs, while not involving direct expenditures, can create jobs and have economic impacts. The Indian Guaranteed Loan Program guarantees up to 90 percent of the amount of loans for Indian-owned enterprises. These enterprises contribute to the economies of federally recognized tribal reservations or service areas. In FY 2012, Interior guaranteed $72.1 million in loans that were issued by banks for a variety of economic development activities. These are loans that the private sector otherwise would not have made. Loans guaranteed by the U.S. Government do not count against legal lending limits, thus this guaranty program may increase the total credit available. Those loan guarantees were estimated to contribute about $45 million in value added economic activity and support about 700 jobs. These are jobs associated primarily with the production activities that were enabled by the loan project. For example, if the loan were made to establish a new clinic, these jobs would entail the construction jobs associated with building the clinic. Over time, these loans would be anticipated to stimulate additional economic activity. For example, if the loan were, again, to establish a new clinic, these jobs would be the estimated number of new jobs to staff the clinic once it is in operation. For FY 2012, it was estimated that this economic expansion would support an additional 490 jobs. Figure 11-1 shows estimated annual value added from investments supported by guaranteed loans.
- Support for tribal government: In FY 2012, this grant funding contributed about $0.8 billion in value added, $1.2 billion in economic output and supported about 10,000 jobs.

Table 11-1. Indian Affairs: Value Added, Output and Employment Supported

Activity	Estimated Value Added	Estimated Economic Output	Estimated Employment Supported
	$ billions		number
Oil, gas, coal	12.6	14.3	67,517
Other minerals	0.14	0.19	1,204
Irrigated agriculture	0.5	1.1	9,758
Forestry	0.29	0.72	3,565
Loan guarantees	0.045	n/a	679
Support for tribal governments	0.8	1.2	10,058
Total	14.4	17.6	93,476

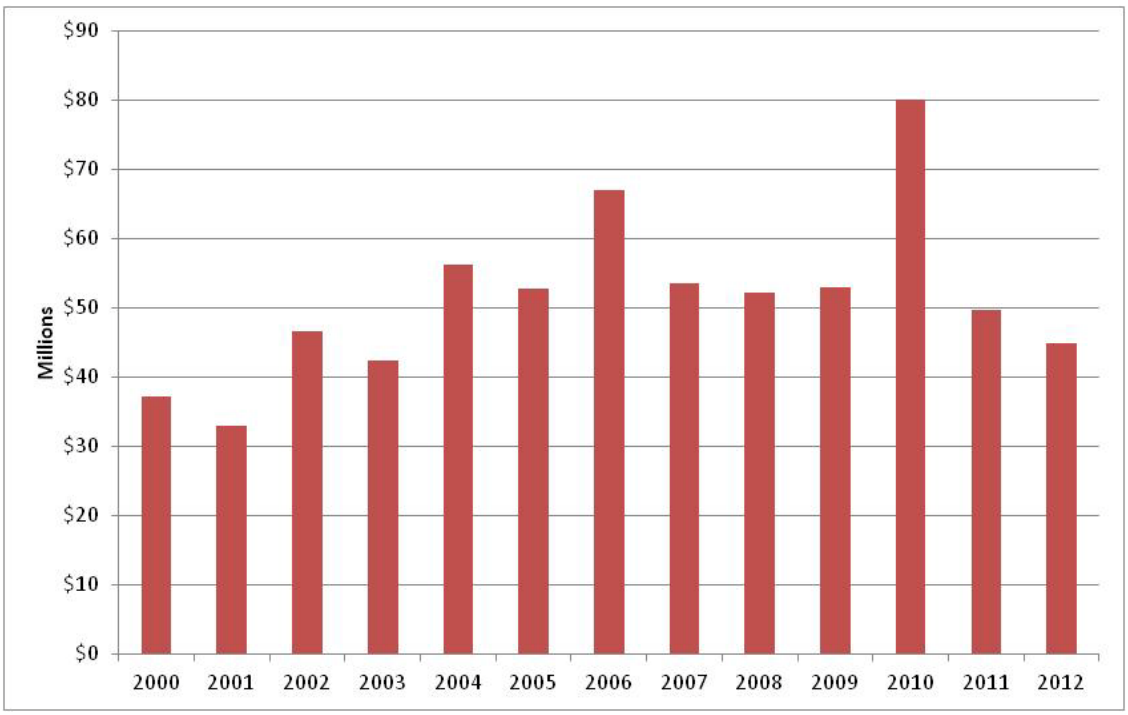

Figure 11-1. Value Added from Investments Supported by Indian Affairs Guaranteed Loans

Source: Based on Indian Affairs estimates.

A number of other activities have important economic components. These are discussed briefly below.

- Education. The BIE serves approximately 41,000 students in 183 schools and dormitories located in 23 states. Most of the students come from remote communities characterized by poorly developed local economies, high rates of unemployment, and low incomes. Many of these communities exhibit above average rates of crime, high percentages of single-parent households, and below average literacy rates. Improvements in education and literacy in tribal communities is essential for improving community life, the promoting economic development, creating better employment opportunities, and increasing the standards of living. At the post-secondary level, BIE operates two colleges, administers grants for 27 tribally operated colleges, funds two tribal technical colleges, and provides tribal scholarships and adult education programs. In FY 2012, the costs of all of these operations totaled $795 million, of which $645 million were spent on elementary and secondary educational programs, $129 million on post secondary programs, and $22 million on education management. In addition, the Department of Education contributed more than $200 million for elementary and secondary educational programs.

  It is widely recognized that educational services offer substantial social and economic benefits. However, these benefits can be difficult to measure. For example, a recent study has found that college-educated workers in the United States over the past two decades have tended to earn incomes that are more than 70 percent higher than the incomes of high school graduates who

have had similar job experience.[85] This study also noted that higher education is linked to improved health and longevity, and civic involvement. These social benefits then translate into economic benefits in countless ways, including improved governance and economic growth.

- Justice Services: In FY 2012, Indian Affairs (IA) spent $357.5 million on public safety and justice services, including the construction of new facilities. Figure 11-2 displays the distribution of these expenditures, in which about half (51.7 percent) was spent on criminal investigations and police services. Another 22.9 percent was spent on detention and correction services, 8.1 percent on tribal courts and tribal justice support, and 3.2 percent on construction improvement and repair. In addition, 14.1 percent was spent on other activities: inspections, special initiatives, the police academy, program management, facilities operation and maintenance, and fire protection. The economic benefits that derive from essential public services can include:
  - Protection of personal rights and property rights, and support of the health and safety of community residents;
  - Lower costs of medical services attributable to fewer incidences of violent crime, and reduced consumption of harmful controlled substances;
  - Human capital development and productive participation of more individuals in the labor force through the design and implementation of programs that encourage individuals, such as juvenile offenders, to become responsible citizens;
  - Economic development facilitated by enhanced safety and security provided to enterprises in the community and to their customers; and
  - Positive spillover effects to businesses that benefit from justice services, such as construction companies that build new facilities, businesses that provide goods and services to justice services employees, etc.

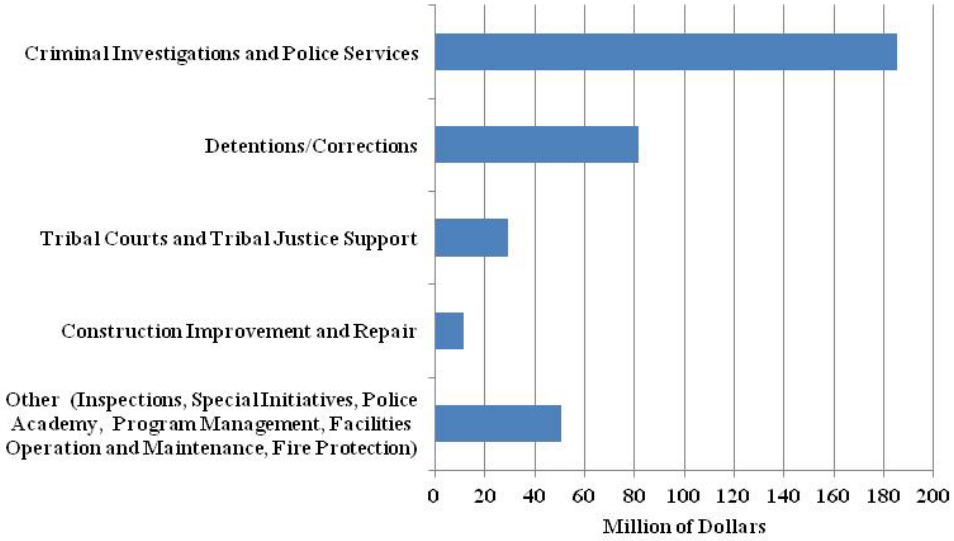

Figure 11-2. Indian Affairs FY 2012 Expenditures on Public Safety and Justice Services

Source: DOI.

[85] Hanushek, Eric. 2009. "*The Economic Value of Education and Cognitive Skills*," in the Handbook of Education Policy Research. Routledge, Pp: 39-56.

- Indian Gaming: The Indian gaming industry has been, by far, the largest source of revenue for Indian Nations. In 2011 (the last year for which data are available) revenues from Indian gaming exceeded $27 billion. Over the last two decades Indian gaming has been generally recognized as a key source of economic growth for Indian Country. IA has played an instrumental role in enabling such growth to occur, through its approval decisions on land taken into trust for gaming operations, and its approval of decisions on compacts between Indian Nations and States which have enabled new gaming operations to be established in those States. Gaming operations have provided jobs and training to Indian people, and generated revenues that support medical and social assistance programs, scholarships for Indian students, and cultural facilities and events that promote awareness in Native American values and heritage. These benefits are not only seen within the tribes that have casinos, but in other tribes that have received philanthropic donations from those tribes that have had particularly successful gaming operations. Indian gaming has also promoted ancillary industries such as resort hotels and restaurants, and recreational facilities such as golf courses and entertainment centers, which have enjoyed the patronage of visitors to the casinos.

While Indian gaming has made its mark on the economic development of Indian Country, its role as the main driver for economic growth in Indian Country appears to have come to an end. As shown in Figure 11-3 Indian gaming revenue grew rapidly from 1998 to 2006, from $8.50 billion to $24.59 billion. However, it has grown little since then, to $27.15 billion in 2011. Like most industries during the recent recession, gaming revenue declined in 2009, but unlike the rest of the economy it has barely risen thereafter. In fact, as shown in the figure, between 2009 and 2011 Indian gaming revenue as a share of the U.S. Gross Domestic Product declined from 0.19 percent to 0.18 percent—the same proportion it had in 2005. While Indian gaming may grow a bit more in the near future, or may tend to keep up with the renewed growth of the U.S. economy, its growth will be limited by three major factors: First, the number of consumers, or more precisely the proportion of the population that gambles, tends to be fairly fixed. Thus, once a population area becomes saturated with gaming facilities, any one gaming operation can only expand at the expense of the other operations in the area. Secondly, new technology in the gambling entertainment industry, especially Internet gaming, will offer competitive alternatives that might erode the customer base for Indian gaming. Finally, some states such as New York have been considering allowing the development of non-Indian casinos for the first time in their state, thereby penetrating and possibly eroding some of the markets for Indian gaming.

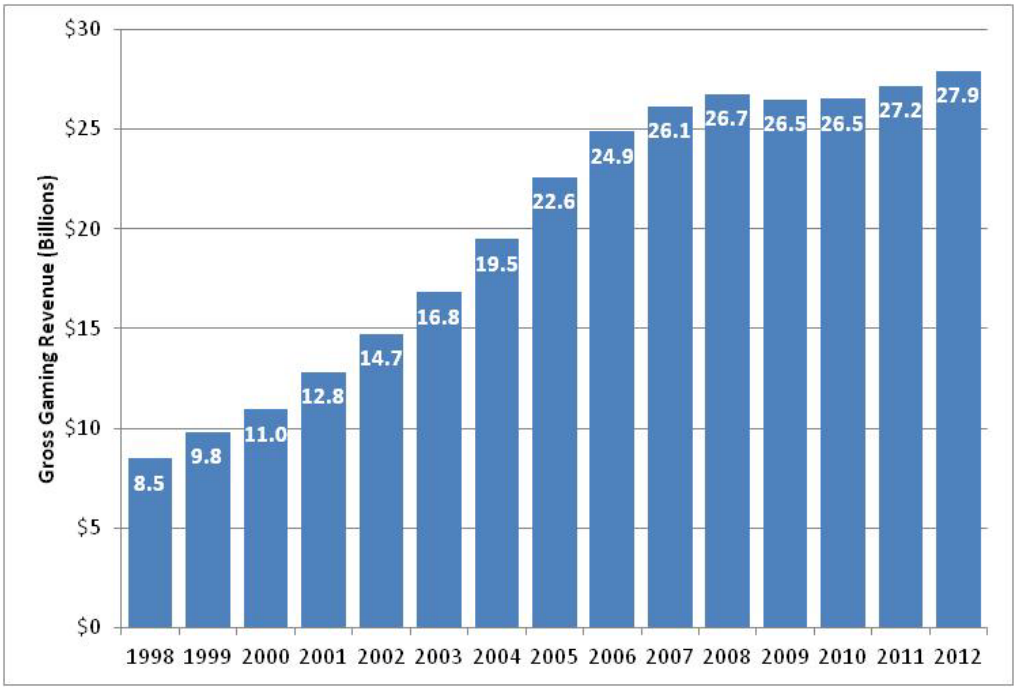

Figure 11-3. Indian Gaming Revenue in Billions of Dollars (1998–2012; not adjusted for inflation)

Source: National Indian Gaming Commission Website (http://www.nigc.gov/Gaming_Revenue_Reports.aspx).

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Chapter 12 Grants and Payments

Introduction

Grants and payment programs administered by Interior provided $7.95 billion in value added; economic contributions of $11 billion; and supported employment of 89,000. Within these totals:

- Indian Affairs grants to support tribal governments provided value added of $0.8 billion, economic contributions of $1.2 billion, and supported over 10,000 jobs.
- Grants and payments to Insular Affairs provided value added of $1.23 billion and supported 35,000 jobs.

The U.S. Department of the Interior (Interior) administers numerous grants and payment programs that support a variety of needs across all fifty states, Native American and Native Alaskan tribes, and U.S.-affiliated Insular Areas. The financial support from these programs helps improve the natural environment (e.g., conservation and restoration of lands, waters, species and their habitat), built infrastructure (e.g., water delivery systems, schools, roads, and bridges), and the provision of public and social services (e.g., resource management planning, law enforcement, and environmental education). Funding for Interior's grants and payment programs comes from several different sources, including: royalty collections from oil, gas, coal, and other mineral production on federally owned or managed lands; excise taxes on fishing equipment and motorboat fuels; excise taxes on firearms, ammunition, archery equipment and arrow components; and annual appropriations. The following provides an overview of the major grants and payment programs, along with their economic contributions. Grants associated with Interior's support for the U.S.-affiliated Insular Areas are highlighted separately, due to their unique and important role for these economies.

A recent Congressional Budget Office report highlights some of the economic issues associated with federal grants to state and local government:[86]

- Grants to state and local governments can promote economic efficiency in instances when those governments have localized knowledge that would permit them to implement a program more efficiently and effectively than the federal government could but when they have insufficient incentives or funding to provide a good or service—infrastructure, for example—whose benefits extend beyond their jurisdictions.
- The federal government allocates grants to state and local governments on the basis of formulas established by law (for block grants and categorical formula grants) or through a competitive process (for project grants). Some formulas are based on historical distributions of grant funds, while others are based on a more complicated set of demographic or other factors relevant to the purpose of the grants.

[86] Congressional Budget Office. March, 2013. *Federal Grants to State and Local Governments*.

- Federal grant programs offer state and local governments varying degrees of flexibility over the use of grant funds. For instance, LWCF grants provide broad parameters for using those funds, leaving state and local governments considerable latitude when they make spending decisions. State and local governments face more spending constraints on how they use categorical formula grants.

Outputs

The funds distributed through Interiors grants and payments programs support a wide range of important purposes and needs. However, this aspect also complicates the ability to measure and quantify outputs generated from these programs in any uniform way. To highlight the wide array of outputs these programs generate for states and local communities, brief descriptions of several of Interior's major grants and payments programs are provided below.

Abandoned Mine Lands (AML) – States with an approved program, or specific Indian tribes, are eligible for Abandoned Mine Land grants, where the funds come from fees paid by active coal mine operators on each ton of coal mined. Funds from the AML program are used for environmental restoration activities to correct or mitigate problems including, surface and ground water pollution, entrances to open mines, water-filled pits, unreclaimed or inadequately reclaimed refuse piles and mine sites (including some with dangerous highwalls), sediment-clogged streams, damage from landslides, and fumes and surface instability resulting from mine fires and burning coal refuse.

Coastal Impact Assistance Program (CIAP) – Provides grant funds from offshore oil and gas lease revenues to oil producing states to conserve, protect, and restore coastal areas including wetlands; mitigate for damages caused to fish, wildlife, and other natural resources; assist with planning and implementation of a federally-approved marine, coastal, or comprehensive conservation management plan; and help mitigate the impact of outer continental shelf activities through funding of onshore infrastructure projects and public service needs.

Cooperative Endangered Species Conservation Fund (CESCF) – Provides grants to States and Territories to participate in a wide array of voluntary conservation projects for candidate, proposed, and listed species on non-Federal lands. States and Territories must contribute a minimum non-Federal match of 25 percent of the total program costs, or 10 percent when two or more States or Territories implement a joint project.

Gulf of Mexico Energy Security Act (GOMESA) – Revenue sharing payments for the four Gulf oil and gas producing States of Alabama, Louisiana, Mississippi and Texas, and their coastal political subdivisions (CPSs). Authorized uses of funds include coastal protection, including conservation, coastal restoration, hurricane protection, and infrastructure directly affected by coastal wetland losses; mitigation of damage to fish, wildlife, or natural resources; implementation of a federally-approved marine, coastal, or comprehensive conservation management plan; mitigation of the impact of outer Continental Shelf activities through the funding of onshore infrastructure projects; and planning assistance and the administrative costs of complying.

Historic Preservation Fund (HPF) – Grants to State and Tribal Historic Preservation Offices to assist in expanding and accelerating their historic preservation activities. Funding is used to pay part of the costs of staff salaries, surveys, comprehensive preservation studies, National Register nominations,

educational materials, as well as architectural plans, historic structure reports, and engineering studies necessary to preserve historic properties.

Land and Water Conservation Fund (LWCF) – The LWCF Program provides matching grants to States and through states to local governments for the acquisition and development of public outdoor recreation areas and facilities (as well as funding for shared federal land acquisition and conservation strategies).

Mineral Revenue Payments – Disbursed by the Office of Natural Resource Revenue, the revenue sharing payments to states include: mineral leasing associated payments; National Forest Fund payments to states; payments to states from lands acquired for flood control, navigation and allied purposes; sales in National Petroleum Reserve – Alaska; royalty payments to Oklahoma; and late interest payments. States use funds for a variety of purposes.

OSM Regulatory Grants to States and Tribes – OSM provides matching grants to States for regulatory programs for coal mining. Grants are provided to 24 States who have approved regulatory programs for the implementation of Title V of the Surface Mining Control and Reclamation Act. Three Tribes are currently provided grants for the development of regulatory coal programs. Some components of a State regulatory program include permitting, inspection of coal mine sites, enforcement of mining laws and regulations, and bond release after mining and reclamation is complete.

Payments in Lieu of Taxes (PILT) – PILT are Federal payments to local governments that help offset losses in property taxes due to nontaxable Federal lands within their boundaries. PILT does not include payments associated with National Wildlife Refuge system lands, which are covered separately under Refuge Revenue Sharing payments.

Refuge Revenue Sharing – The U.S. Fish and Wildlife Service makes revenue sharing payments to counties for the lands that they administer. Through the Refuge Revenue Sharing Act, as amended in 1964, either 25 percent of the net receipts collected from the sale of various products or privileges from refuge lands or 3/4 of 1 percent of the adjusted purchase price of refuge land, whichever is greater, are paid to counties where refuge lands are located.

Sport Fish Restoration – The Sport Fish Restoration Program (SFR) provides grant funds to the states, the District of Columbia and Insular Areas fish and wildlife agencies for fishery projects, boating access and aquatic education. Funding is generated through excise taxes on fishing equipment, motorboat and small engine fuels, import duties, and interest.

State and Tribal Wildlife – The State Wildlife Grant Program uses funds appropriated from Congress to provide federal grants for developing and implementing programs that benefit wildlife and their habitats, including species not hunted or fished. Grant funds must be used to address conservation needs such as research, surveys, species and habitat management, and monitoring, identified within a State's Comprehensive Wildlife Conservation Plan/Strategy. Similarly, the Tribal Wildlife Grant Program uses funds from an annual appropriation to provide funds to federally recognized Tribal governments to develop and implement programs for the benefit of wildlife and their habitat, including species of Native American cultural or traditional importance and species that are not hunted or fished.

WaterSMART – Grant provide cost-shared funding for the following types of projects: Water and Energy Efficiency Grants for projects that save water, improve energy efficiency, address endangered species and other environmental issues, and facilitate transfers to new uses; System Optimization Review Grants for a broad look at system-wide efficiency focused on improving efficiency and operations of a water delivery system, water district, or water basin where the results in a plan of action that focuses on improving efficiency and operations on a regional and basin perspective; Advanced Water Treatment and Pilot and Demonstration Project Grants for pilot and demonstration projects that address the technical, economic, and environmental viability of treating and using brackish groundwater, seawater, impaired waters, or otherwise creating new water supplies within a specific locale; Grants to Develop Climate Analysis Tools for research projects focused on the information gaps detailed in the joint Reclamation and United Stated Army Corps of Engineers (USACE) Report titled "Addressing Climate Change in Long-Term Water Resources Planning and Management: User Needs for Improving Tools and Information" (Section 3).

Wildlife Restoration – The Wildlife Restoration Program provides grant funds to the states and Insular Areas fish and wildlife agencies for projects to restore, conserve, manage and enhance wild birds and mammals and their habitat. Projects also include providing public use and access to wildlife resources, hunter education and development and management of shooting ranges. Funds are generated through excise taxes on firearms, ammunition, archery equipment and arrow components.

Economic Contributions and Economic Value

Several of the major grants and payments programs, and FY 2012 funding, administered by Interior and its bureaus are shown in Table 12-1.

Grants and payments totaling about $5 billion supported about 89,000 jobs, $7.95 billion in value added, and $11 billion worth of economic contributions in FY 2012. The largest payments are associated with mineral revenues. These mineral revenue payments totaled about $2.1 billion in FY 2012 and were associated with value added of about $3.3 billion and economic contributions of $5 billion. The economic contribution estimates for the major grants and payments programs presented in this section have not been captured in the economic contribution estimates provided in other sections of this report and therefore, do not represent double-counting.

Table 12-1. Economic Contributions of Interior's Major Grants and Payments Programs

Grant/Payment Program	FY 2012 Funding ($ billions)	Estimated Value Added ($ billions)	Estimated Economic Output ($ billions)	Estimated Employment Supported (jobs)
Abandoned Mine Lands Grants	0.49	0.72	1.21	7,817
Coastal Impact Assistance Program Grants	0.48	0.76	1.15	9,545
Cooperative Endangered Species Conservation Fund Grants	0.05	0.07	0.11	902
Historic Preservation Fund Grants	0.05	0.07	0.14	959
Land and Water Conservation Fund Grants to States w/ GOMESA	0.04	0.05	0.10	671
Mineral Revenue Payments	2.08	3.25	4.93	41,067
OSM Regulatory Grants	0.07	0.11	0.16	1,351
Other National Park Service Grant Programs	0.01	0.01	0.02	155
Payments In Lieu of Taxes	0.39	0.61	0.93	7,742
Refuge Revenue Sharing	0.02	0.03	0.04	338
Sport Fish Restoration Grants	0.43	0.66	1.02	8,344
State and Tribal Wildlife Grants	0.06	0.09	0.14	1,147
Tribal Governments Support[1]	0.58	0.84	1.21	10,549
WaterSMART Grants	0.01	0.01	0.02	135
Wildlife Restoration Grants	0.39	0.61	0.94	7,675
Total	5.15	7.91	12.11	98,395

[1] Includes aid to tribal governments, consolidated tribal government program, self-governance compacts, contract support, Indian self-determination fund, new tribes, small and needy tribes, and road maintenance.

Beyond the resulting economic contributions, Interior's grants and payments funds received by states and local communities help support valuable improvements to the natural environment (e.g., conservation and restoration of lands, waters, species and their habitat), built infrastructure (e.g., water delivery systems, schools, roads, and bridges), and the provision of public and social services (e.g., resource management planning, law enforcement, and environmental education). Measuring the economic value of the various grants and payments depends on the specific activities and/or projects the funds are used for. Under the Gulf of Mexico Energy Security Act (GOMESA), funds dispersed to the four Gulf oil and gas producing states of Alabama, Louisiana, Mississippi and Texas, and their coastal political subdivisions (CPSs) are to be used for coastal protection, including conservation, coastal restoration, hurricane protection, and infrastructure directly affected by coastal wetland losses;

mitigation of damage to fish, wildlife, or natural resources; implementation of a federally-approved marine, coastal, or comprehensive conservation management plan; mitigation of the impact of outer Continental Shelf activities through the funding of onshore infrastructure projects; and planning assistance and the administrative costs of compliance. While GOMES funds can be used for a variety of purposes and projects, some activities may help conserve and restore habitat for numerous species of birds and fish along the Gulf coast, but also help safeguard coastal communities against future storm events. Recreationists may benefit from improved conditions for fishing, hunting, and nature observation resulting from habitat conservation and restoration, while coastal residents and businesses may benefit from potential avoided property damages in future storms. Determining the economic value such project expenditures would require information on a specific project(s) implemented and involve using appropriate economic methods to quantify the dollar value of the benefits to recreationists and/or the dollar value of the potential avoided property damages to the local coastal community.

Measuring the economic value of other Interior grants and payments programs would involve an approach similar to the simplified example described above on the use of GOMESA funds by Gulf coast states. In general, it is important to have an understanding of the specific project(s) implemented or actions taken by states and local communities that receive the grants and payments funds as well as the resulting incremental changes from the project(s) or actions. Furthermore, it is also necessary to identify the user groups or stakeholders that will benefit from the particular projects or actions taken. Appropriate economic valuation methods can then be used to estimate the dollar value of the benefits. Furthermore, comparing expenditures for individual projects to their estimated benefits will provide a measure of net benefits received by states and local communities.

Insular Affairs

Interior's Office of Insular Affairs (OIA) carries out the department's responsibilities for U.S.-affiliated Insular Areas, which include the territories of Guam, American Samoa, the U.S. Virgin Islands, the Commonwealth of the Northern Mariana Islands, and three sovereign freely associated states (FAS, which includes the Federated States of Micronesia, the Republic of the Marshall Islands, and the Republic of Palau). The OIA assists the Insular Areas in developing more efficient and effective government by providing financial and technical assistance—primarily via grant programs—and helps manage the Federal Government's relationships with Insular Areas by promoting appropriate Federal policies. OIA works to improve the financial management practices of insular governments, maximize economic development opportunities, improve quality and quantity of economic data and increase Federal responsiveness to the unique needs of island communities.

OIA's responsibilities are framed by the long-term security interests of the United States in the western Pacific and serious economic and fiscal problems affecting the U.S. territories and FAS. Although each Insular Area's situation is unique, they share common challenges, including limited land and resources; small populations; limited local technical expertise; narrow economic bases; and exposure to natural disasters, such as hurricanes and typhoons. The Department of the Interior's OIA and the Department of Commerce's Bureau of Economic Analysis (BEA) will expand the current measures of economic activity

for American Samoa, Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and the U.S. Virgin Islands to include additional information to gauge territorial economic performance.

Table 12-2 provides select economic characteristics of Insular Areas to help highlight some of the challenges they face, as seen where GDP per capita is significantly lower in most Insular Areas compared to the United States. In an effort to combat the many challenges facing Insular Areas, the OIA strives to empower the local communities, foster economic development, promote sound management, and improve quality of life while respecting and preserving local cultures.

Table 12-2. Economic Characteristics by Insular Area

	Estimated Population (#)	Estimated Employment (#)	Estimated Employee Compensation ($'000, 2011$)	GDP ($'000, 2011$)	GDP per Capita (2011$)
American Samoa	55,519	15,434	242,452	634,413	11,427
Guam	159,358	68,025	1,679,585	4,721,474	29,628
Northern Mariana Islands	53,883	21,399	317,984	756,137	14,033
U.S. Virgin Islands	106,405	45,095	1,544,992	4,639,981	43,607
Micronesia	102,843	15,924	68,314	310,288	2,994
Marshall Islands	52,921	10,482	101,566	170,748	3,212
Palau	20,472	11,678	102,759	179,900	8,729
United States	309,349,689	-	-	-	48,442

Source: Reprint of Table 1-1 from Economic Impacts Attributable to FY 2012 Federal Grants and Payments to Seven Insular Areas, Final Report, RTI International, December 2012. Available online at: http://www.doi.gov/oia/reports/OIAeconomicreports.cfm.

In FY 2012, the budget of the OIA was $571 million, of which $544 million was direct grants and payments to the Insular Areas. A large majority of the grants and payments to Insular Areas are considered mandatory, essential assistance to provide basic services or defined by law, while only a small percentage is considered discretionary.[87] OIA payments fund health care, education, government operations, roads, and other types of social and physical infrastructure. From a budgetary standpoint, payments can be separated into three primary categories:

- Fiscal payments, which are the return of taxes collected by the U.S. federal government to Guam and the U.S. Virgin Islands, as required by law;
- Assistance to Territories, which provides general technical assistance; finances education and health care operations; funds and maintains essential infrastructure; and supports environmental initiatives, including brown tree snake control and the Coral Reef Initiative;

[87] The United States Department of the Interior Budget Justifications and Performance Information Fiscal Year 2013: Office of Insular Affairs. http://www.doi.gov/archive/oia/budget/FY2013_Budget_Justification.pdf

- Compact of Free Association, which distributes annual payments to FAS, per their treaties with the United States, and provides support to the U.S. western Pacific territories and Hawai`i to offset the impact the Compact has on the region.

Overall, the direct grants and payments to Insular Areas in FY 2012 were estimated to result in contributions to GDP totaling $1.2 billion, while supporting 35,000 jobs. While the GDP contribution represents 11% on average across the Insular Areas, in some Insular Areas it represents a significantly higher proportion of GDP (American Samoa – 21%; Micronesia – 59%; Marshall Islands – 62%; and Palau – 32%).

Chapter 13 Science, Data and Information

Introduction

Investments in research and development promote economic growth and innovation, ensure American competitiveness in a global market, and are critical to achieving the mission of the U.S. Department of the Interior (DOI or Interior). Investments in Interior's research and development will improve U.S. strategic mineral supplies, water use and availability, and natural hazard preparedness. Sustainable stewardship of natural resources requires strong investments in research and development in the natural sciences. This chapter focuses on information developed by the bureaus through research or systematic data collection, and activities that facilitate the transfer of information to the private sector.

Interior develops and disseminates scientific information that increases the public's understanding of the Earth and its natural systems, minimizes loss of life and property from natural disasters, and supports the management of public resources like water, ecosystems, energy and minerals. This information is valuable as an input to various production processes, and in supporting a range of markets and market activities. Nevertheless, the full value the scientific information and data produced by Interior is difficult to assess, as there are few markets for pure information.

Interior's bureaus are engaged in a variety of activities designed to provide basic research, scientific and technical information, and to transfer technology to decision makers in the public and private sectors. The information produced by Interior is a critical input that helps support private markets, the production processes of private entities, and many public sector decisions. For example, oil, gas, and mineral markets are underpinned by scientific and technical information on resource availability; water use and allocation decisions rely on precipitation and runoff predictions; and preparedness for natural hazards relies on information about the locations and probability of such events occurring. Interior is involved with producing and disseminating all of these types of information, which have an economic value that is at least partly incorporated in the market prices of traded goods and services. In some cases, the economic value of information is associated with reducing the uncertainty facing market participants or decision makers. In other cases the value of information is associated with the impetus it provides for technological change and associated efficiencies.

Background

Information resulting from government research and development activities is often available at little or no cost to the user, providing an inexpensive input to decision making. In general, information and data sources generated through DOI research are used in both the private and public sectors for a variety of end-uses that generate significant societal benefits.

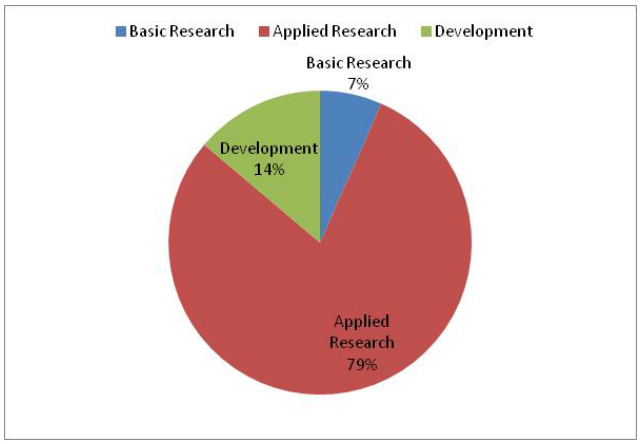

Figure f. Distribution of DOI Research Funding (FY 2012)

Research and development spending at DOI can be broken into the following broad categories: basic research; applied research; and development. Figure displays the distribution of funding across those categories in FY 2011.[88]

DOI generated information and data are used both directly and indirectly as an input to production processes or decision making by federal, state and local governments, private markets, and the general public. For instance, The National Weather Service, U.S. Army Corps of Engineers, the Federal Emergency Management Agency and, through them, the broader public, rely on input from continuous records of streamflow information provided by the USGS streamgaging network for timely and accurate flood forecasts and warnings, flood management, and disaster mitigation. The same streamflow information is directly used by boaters, swimmers, and fishermen in their decisions to pursue their chosen activities.

Providing public access to the variety of data that is generated, managed, and stored by DOI is becoming increasingly important in the digital age. Numerous web and mobile phone applications have been developed, either directly by DOI bureaus or indirectly through the use of DOI data. This has provided the American public with easy access to a wide range of information, including real-time and historical streamflow measurements, flood hazard information, earthquake activity data, and national park websites and maps, to name just a few. Scientists at the U.S. Geological Survey (USGS) are even encouraging the public to think of innovative new applications based on the bureau's ecological and biological datasets through their "App-lifying USGS Earth Science Data" contest.[89]

Data and information generated through Interior's activities are also used to support state and private business activities. For instance, thermal data unique to Landsat satellite imagery has been critical in the development of METRIC (Mapping EvapoTranspiration at high Resolution with Internalized Calibration), a model that computes and maps evapotranspiration based on digital images from the Landsat satellite. The Idaho Department of Water Resources uses METRIC to create water budgets for the state, and METRIC has been used to settle water disputes and monitor water compacts such as the North Platte River decree between Nebraska and Wyoming. METRIC has also been used as evidence in court cases

[88] FY 2013 Analytical Perspectives, Table 22-1.
[89] See http://applifyingusgsdata.challenge.gov/ for more information.

such as the A&B Irrigation District case in Idaho and the Antelope Valley Groundwater class action suit in California. Agencies in over fifteen states are using METRIC in innovative ways to solve and prevent problems related to water resource management. Further, METRIC is utilized by the private sector. For instance, E. & J. Gallo, the world's largest family owned winery and largest exporter of California wines, uses the model to estimate potential and actual vineyard water uses. This allows the winery to decrease the amount of water used for irrigation and improve wine quality. This model and the innovative uses it has been put towards would not exist without Landsat's unique, high-resolution thermal data, which can show water use at the individual field level.

Commercialization of new technologies is an important stage in the process of innovation. In some cases, government research and development activities might follow a path from basic research, to applied research, to the development of specific technologies that can be transferred to the private sector, resulting in commercial applications. Such activities may be undertaken collaboratively between DOI and external entities such as industry, universities, trade associations, and state and local governments. Arrangements such as Cooperative Research and Development Agreements (CRADAs) help facilitate partnerships between the Federal government and non-Federal entities, as well as the efficient transfer of federally conceived or developed technology into the private sector.[90] One such agreement was entered into between the Bureau of Reclamation and Marrone Bio Innovations, who together, conducted field trials of Zequanox, an innovative solution to controlling invasive mussels that have caused billions of dollars in damages to the economy. This product is now commercially available.

Outputs: Research and Technology Transfer

The material below provides an overview of some of the different types of information produced by DOI, and the economic concepts associated with this information. A number of Interior bureaus conduct research and data collection to support their individual mission. Some selected highlights are described below.

Research

The Department has substantial research efforts underway to help understand the impacts of climate change. The DOI Climate Science Centers (CSCs) and Landscape Conservation Cooperatives (LCCs) conduct research and monitoring and

Earthquake Early Warning System

The USGS has been working with academic and private partners to develop an earthquake early warning system for the state of California. This system is still being tested, but was successful in providing thirty seconds of warning time before a recent earthquake hit Anza, California. With additional sensors and system testing and refinement, this pilot project has the potential to be expanded into a publically available statewide network.

[90] Some of the benefits provided by CRADAs include: enabling both partners to leverage their research budgets and optimize resources; providing a means for sharing technical expertise, ideas, and information in a protected environment; permitting federal scientists to work closely with their non-federal counterparts; offering non-federal partners access to a wide range of expertise in many disciplines; allowing the partners to agree to share intellectual property emerging from the effort; and permitting the Federal Government to protect information emerging from the CRADA from disclosure for up to 5 years, if this is desirable. (Source: Technology Transfer Handbook for the U.S. Geological Survey, 2003).

communicate research findings to improve understanding of climate change impacts and vulnerabilities. The LCCs are also deeply engaged in adaptation planning, thus serving as a key science-management bridge. This joint effort helps to support strategic decisions in response to vulnerabilities: the DOI CSCs will be centers for basic climate change science associated with broad regions of the country; and LCCs will focus on applied science and management decision making at the landscape level. Interior is also conducting climate change vulnerability assessments across the United States in an effort to determine the resources that are most vulnerable and assess the threats to resources that may be exacerbated by climate change.

U.S. Geological Survey

As Interior's primary science organization, the U.S. Geological Survey (USGS) operates many programs which provide easily accessible historical and real-time scientific data to national and international users on a wide array of topics. A considerable amount of the bureau's work is supported through cost sharing and reimbursable efforts. In particular, USGS addresses:

- Energy and mineral assessments;
- Natural hazards;
- Climate and Land use change;
- Understanding of ecosystems;
- Environmental health; and
- Water resources.

Data collected by USGS contribute to an increased understanding of natural resources and hazards, which improves the accuracy of hazards forecasting, societal resilience to natural hazards, land-use planning, and decision making, all of which has considerable economic value. Some example programs include:

- The Earthquake Hazards Program, which provides near real-time maps of ground motion and shaking intensity following significant earthquakes;
- The Volcano Hazards Program, which conducts continuous, real-time monitoring of volcanoes in the United States and issues warnings of impending eruptions to help prevent loss of life and property;
- The National Streamflow Information Program, which provides historical and real-time streamflow data for the Nation;

GeoMine

The OSM's GeoMine Pilot Project is exploring the feasibility of producing a web-based geospatial map of active, idled or reclaimed mine areas in the United States. The pilot-project phase begins with the mines in four Appalachian States — Virginia, West Virginia, Tennessee, and Kentucky. In addition to the four State programs and OSM, contributing partners in this project include the EPA, Corps of Engineers, and the FWS. The interagency team is now in the process of drafting a final report. To date GeoMine has digitized geographic data on 71,000 SMCRA boundaries in the four pilot States. The GeoMine Pilot Project was selected by the Federal Geographic Data Committee for national recognition as one of ten Federal projects to be included in the Administration's GeoCloud II demonstration project.

- The National Water Quality Assessment Program, which provides an understanding of water-quality conditions; whether conditions are getting better or worse over time; and how natural features and human activities affect those conditions; and
- The Land Remote Sensing Program, the Nation's archive for the world's largest collection of civilian remotely sensed data covering the Earth's land masses. After an unparalleled 28 years of providing imagery, Landsat 5 was decommissioned in 2012. During 2013, Landsat 7 operations will continue, as will the collecting, archiving, processing, and making Landsat imagery available through the Internet. In 2012, more than 3 million Landsat scenes were distributed to scientists and other customers worldwide. The Landsat Data Continuity Mission (successfully launched on February 11, 2013 and now known as Landsat 8) is now the main source of Landsat imagery.

Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement

The Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE) manage natural gas, oil and other mineral resources on the Outer Continental Shelf (OCS). These resources provide a significant amount of the U.S.'s energy supply as described in Chapter 4 Energy from Fossil Fuels.

BOEM periodically conducts oil and gas assessments of the OCS to determine the amount of undiscovered technically recoverable resources, as well as the quantity of undiscovered economically recoverable resources. This information underlies leasing and management decisions on the OCS and serves as an important input to energy markets.

To support this work and inform bureau policy decisions, BOEM's Environmental Studies Program (ESP) plans, conducts and overseas world-class scientific research. These environmental studies cover a broad range of disciplines, including physical oceanography, atmospheric sciences, biology, protected species, social sciences, economics, submerged cultural resources and the environmental impacts of energy development. BOEM incorporates findings from the studies program into its environmental reviews and NEPA documents, which are used to determine steps to avoid, mitigate, or monitor the impact of energy and mineral resource development on the OCS. Through the ESP, BOEM is a leading contributor to the growing body of scientific knowledge about the marine and coastal environment. The bureau has funded nearly $1 billion in research since the beginning of its studies program in 1973. Completed studies are available to the public through the Environmental Studies Program Information System (ESPIS).

The BSEE is the principal Federal agency funding offshore oil spill response research. BSEE research provides leadership to improve the knowledge and capability for the detection, containment, and cleanup of oil spills that may occur on the OCS. BSEE's research program also seeks to develop technologies such as the use of satellite imagery, side looking infrared radar, and other remote sensing tools to improve response tactical decisions and thus improve response and safety of offshore workers. The BSEE Oil Spill Response Research (OSRR) program also funds Oil Spill Response research in five areas: (1) mechanical, (2) chemical, (3) remote sensing, (4) command and control, and (5) recovery in Arctic Conditions. BSEE funded about $15 million of oil spill research in FY 2012. The oil spill research is funded through the Oil Spill Liability Trust Fund. By funding this research BSEE aims to develop and test the next generation of spill response technologies.

The research program addresses technological issues associated with energy and mineral operations, ranging from the drilling of oil and gas exploration wells in search of new reserves to the removal of platforms and related infrastructure once production operations have ceased. The results of these studies have also contributed to the development of a number of BSEE regulations, BSEE NTLs, Industry Standards (American Petroleum Institute; API), American Society for Testing and Materials (ASTM), and International Standards. The material below offers examples of each:[91]

- Regulations: Results from an initial shear ram capability study/information helped to inform the requirement for shear ram capabilities found in 30 CFR 250.416(e);
- BSEE issued Notice to Lessees (NTL) No. 2009-G03: Synthetic Mooring System Materials for Floating Facilities intended to demonstrate that synthetic moorings meet or exceed the safety level necessary for chain/wire-rope mooring systems;
- Industry Standards (API): Development of the draft API RP 2RD, Dynamic Risers for Floating Production Installations. In addition to providing the study's work to the API, these same results have been presented to the International Organizations for Standardizations (ISO) for possible incorporation in the equivalent international standard, ISO 13628-12;
- ASTM Standards in Association with BSEE Ohmsett Test Facility: F1607-95 (2008) Standard for Oil Spill Response Pumps; and
- International Standards: A TA&R study laid the groundwork for reviewing the International Electrotechnical Commission Standards for Offshore Wind Farms design standards for applicability on the U.S. OCS. Since then, an American Wind Energy Association(AWEA) effort has been established to 'roadmap' the use of this international standard by supplementing it with the appropriate U.S. standards where there is a variance, and identifying gaps that could potentially be augmented with other standards, and/or gaps that require that additional standards be drafted. Two subsequent TA&R studies will be valuable contributions to this effort.

Bureau of Reclamation

The Bureau of Reclamation's Science and Technology Program is the bureau's primary Research and Development arm, responsible for evaluating and funding research projects to further Reclamation's mission of helping the American West fulfill its growing demands for water, while protecting the environment and the public's infrastructure investments. To address technical and scientific challenges facing the provision of water and power to the 17 Western States, the bureau's Research and Development Office over the past seven years has funded 800 research projects focused on innovative solutions to these challenges.

Current research projects include:

- Conserving or expanding water supplies;
- Advanced water treatment technologies; and
- Water operations decision support.

[91] See BSEE FY 2013 Budget Justification for additional details.

Reclamation also provides near real-time water and environmental data collected by a network of hydrologic and meteorologic monitoring stations, collectively referred to as Hydromet. As DOI's primary water management agency, Reclamation is also playing a large role in the implementation of Interior's WaterSMART (Sustain and Manage America's Resources for Tomorrow) Program, which establishes a national framework for sustainable water use through the coordination of Interior bureaus, states, tribes, local governments, and non-governmental organizations.

Office of Surface Mining Reclamation and Enforcement

One of the purposes of the Surface Mining Control and Reclamation Act of 1977 (SMCRA) is to help States develop and implement their own approved surface coal mining programs. The Office of Surface Mining Reclamation and Enforcement (OSM) achieves this in part by providing technical assistance based on sound science, and training to its State and tribal partners to enhance their ability to maintain effective programs. Although OSM has no formal research and development activities, it's Technology Development and Transfer program promotes and disseminates information on technological innovations to better protect the environment during mining and in reclaiming and restoring active and abandoned mines. The program also provides training to ensure that States, Tribes, and the bureau's other partners continue to administer their surface mining programs efficiently and effectively.

Bureau of Land Management

The Bureau of Land Management (BLM) is a multiple-use land management agency within Interior, responsible for administering approximately 248 million surface acres. Activities on these lands include recreation, energy development, mining, logging, livestock grazing, and management of wild horses and burros. To balance these varied

Desalination

During 2012, Reclamation entered into a Material Transfer Agreement (MTA) with Dow Chemical Company (Dow) to evaluate Reclamation's recently patented desalination membrane to purify water while resisting chlorine degradation. A significant deficiency of industry standard desalination membranes is their poor ability to resist chlorine degradation. This is important because chlorine dosing is vital to the water treatment process in order to prevent membrane biofouling. Under the agreement, Reclamation provided Dow with its patented chemical membrane formulation to manufacture a set of full-scale membranes for prototype testing. Dow provided their manufacturing know-how and capability to scale-up the Reclamation formulation into the full size membranes and also provided a set of the current Dow industry-standard membranes for comparison testing. The membranes were tested by Reclamation at Reclamation's Yuma Area Office-Water Quality Improvement Center. Results indicate the new Reclamation formulation performed well, but did not exceed that of the Dow industry standard. The patented Reclamation formulation has many derivations and patent applications for additional new formulations filed by Reclamation during 2012. Reclamation and Dow are now considering an expanded collaborative agreement to jointly evaluate and test a broader spectrum of Reclamation's formulations. If formulations are found to perform significantly better than current industry standards, subsequent collaborative activities would be pursued to mature the formulation(s) into commercially available membranes.

uses, BLM's decisions draw upon scientific data and information sources. Examples of information produced by BLM include:

- Visitor use surveys and research conducted by BLM's National Recreation Office, which incorporate information obtained from the public into resource management decisions;
- The Wild Horse Identification and Management System, a visual database used by federal wild horse managers, federal adoption program managers, individual horse owners, academic researchers, and federal and state land managers to identify wild horses and track information on them; and
- Monitoring data on rangeland conditions.

Public access to a wide variety of BLM geospatial data and products is available through GeoCommunicator. This publication site provides interactive mapping of public land survey system data, BLM lands and administrative areas, energy corridors, oil and gas sale parcels, wild horse and burro areas, and abandoned mines. All of this information is available for public use in a Geographic Information System (GIS), which offers easy communication via map interface.

National Park Service

The National Park Service (NPS) plays a critical stewardship role, preserving the natural resources on the lands it manages to provide for the enjoyment and education of current and future generations. Much of the scientific information collected by NPS is done within its Inventory and Monitoring (I&M) Program, established in 1992. This program conducts natural resource inventories and monitors the status and trends of various park resources. NPS's I&M Program collects a wide range of natural resource data from the nation's parks. The agency regularly monitors a range of vital ecosystem indicators such as soil structure, water quality, water quantity, wetland and grassland vegetation, among many others, in an effort to improve management of natural resources within the National Park system.

NPS administers twelve "Baseline" natural resource inventories including the Natural Resource Bibliography, base cartography data, air quality data, a vegetation inventory, species occurrence and distribution, and much more. NPS also uses data and information obtained through surveys of the public to inform park management and planning.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (FWS) is charged with conserving the nation's fish, wildlife, plants and their habitat. FWS plays a large role in generating and collecting scientific data and information used to meet this objective. For example, the FWS's Migratory Bird Data Center (a partnership with the USGS) houses extensive data sets and information on various bird populations and habitats in an effort to support conservation activities. Data sets collected through bird inventories, surveys, and monitoring programs are used to assess the status and trends of North American bird populations and facilitate planning and evaluation of bird conservation strategies and overall natural resource management. Long-standing surveys such as the Waterfowl Breeding Population and Habitat Survey date back to the 1950s and represent a successful partnership in data collection efforts between the FWS and the Canadian Wildlife Service. This survey provides population and trend information for various North American

duck species and provides critical information used in the establishment of hunting regulations, as well as in waterfowl conservation. Hunter activity and harvest data are also available at this data center.

Technology Transfer

There were a total of 379 active Cooperative Research and Development Agreements (CRADAs) in FY 2012, of which 284 were newly executed. In addition there were 283 other collaborative R&D arrangements with various parties, including 165 that were new in FY 2012. Table 13-1 provides a summary by bureau. Also, in FY 2012, through the publication of over 2,300 reports, books, fact sheets, and other publications, the Department's scientific, technical and engineering personnel engaged in a broad range of cooperative activities to develop and disseminate innovative technologies.[92] A summary of the activities undertaken in FY 2012 is provided in Table 13-1. Some specific examples of actions in FY 2012 include:

- Disclosure of 10 new inventions. In addition, three patents were filed and three patents were issued.
- Managing 26 licenses for inventions and other intellectual property earning over $78,000.
- Drafting a new Departmental Manual chapter that will establish Department policies and procedures for implementing and administering technology transfer agreements.

Table 13-1. Collaborative Relationships for Research and Development

FY 2012	USGS	FWS	Reclamation	BSEE	TOTAL
CRADAs, total active in the FY(1)	365	4	10		379
New, executed in the FY	283		1		284
Traditional CRADAs,(2) total active in the FY	17	4	7		28
New, executed in the FY	5				5
Non-traditional CRADAs,(3) total active in FY	348		3		351
New, executed in the FY	278		1		279
Other collaborative R&D relationships					
Collaborative Agreements, total active in the FY	275	n/a		8	283
New, executed in the FY	158	n/a		7	165

Source: U.S. Department of the Interior. Annual Report on Technology Transfer FY 2012 Activities, January 2013.

[92] The source of the material in this section is: U.S. Department of the Interior. Annual Report on Technology Transfer FY 2012 Activities January 2013.

Economic Value

Information is a valuable economic resource. It improves decision making by reducing the uncertainty of outcomes. Publically provided scientific data and information sources generate significant societal benefits, and quantifying the return on the public's investment in the development of scientific information and transfer of federal technology has become increasingly important. In concept, the value of information can be evaluated using standard economic techniques such as benefit-cost analysis. However, evaluating the net economic benefits of the scientific information provided by DOI presents some challenges, one of which is related to the "public good" nature of the data and information provided.[93]

An additional challenge stems from the fact that the information generated through DOI research has a variety of national (and sometimes international) uses, providing economic benefits that could be monetized in different ways. Further, this information is often shared freely among users, making quantification of its total value to society challenging. One of the key components to developing estimates of value is identifying the full range of existing users and uses of a particular data or information source. . However, few such studies have been conducted to date. In addition, much of the information provided by Interior bureaus has few or no substitutes, so it may not be possible to use secondary sources to quantify its value. Despite these challenges, significant advancements have been made in communicating the economic value of data and information sources, through both qualitative and quantitative approaches.

Within Interior, the U.S. Geological Survey (USGS) has carried out a number of studies monetizing the economic benefits associated with the uses of scientific and technical data and the information these provide. Beginning in the 1990s, a number of studies have estimated the value of geologic maps (Bernknopf et al., 1993; Halsing et al., 2004; Bernknopf et al., 2007); earth science information (Bernknopf et al., 2001); and satellite imagery (Miller et al., 2011). These studies all provide estimates of the economic value for a sample of the end uses which publically provided data and information sources are put towards. However, for reasons mentioned previously, these estimates are neither comprehensive nor certain.

[93] *Public goods*, as defined by economists, are goods which have the characteristics of *non-rivalry* and *non-excludability*. Goods with these characteristics are often, but not always, provided by the public sector. *Non-rivalry* implies that, in general, the additional cost of one more person using this type of good is typically zero. For example, if one individual goes to the USGS Earth Resources Observation and Science Center website and downloads a particular satellite image, this does not affect the availability or cost of providing this same image to other users. *Non-excludability* implies that individuals cannot be prevented from using the good. In direct contrast, private goods are both *rival* and *excludable*, and are provided through private markets. In the absence of market failures, forces of supply and demand set an efficient market-clearing price.

Exploring the Value of Landsat Imagery

Landsat satellites provide remotely sensed imagery, archived back to 1972, allowing for broad-area analyses over several decades. The imagery has been collected globally on a regular basis, providing unique repeat coverage. This imagery is available at no cost and with no restrictions from the U.S. Geological Survey (USGS). Since Landsat imagery is provided at no cost, there is no market price for it, which makes determining the value of the information provided by the imagery more difficult. Landsat is used in a huge variety of applications by hundreds of thousands of people, implying substantial value. The free and open data policy resulted in a hundredfold increase in scenes distributed annually from USGS and a tenfold increase in the number of users registered with USGS. These trends indicate that the value of Landsat is increasing.

In 2012, a survey of more than 11,000 Landsat users registered with USGS was conducted by the Policy Analysis and Science Assistance Branch at the USGS Fort Collins Science Center to explore the value of the imagery to users. By exploring the value of Landsat imagery with a variety of metrics, a comprehensive picture of the value of the imagery was created. The majority of users felt Landsat was important to their work and said they were moderately to very dependent on the imagery to complete their work. This dependence on the imagery is also demonstrated by the 62% of users who stated that they would have to discontinue work if archived and new Landsat imagery was no longer available. On average, these users estimated they would discontinue half of their current work. Additionally, almost a third of users believed their costs would increase if Landsat imagery was no longer available. These users estimated their average increase in costs would be 82%. Though all Landsat imagery is unlikely to disappear, there was a gap in new imagery provision from Landsat 5 before and during the survey. A large majority of users (79%) reported using Landsat 5 imagery in the year prior to the survey and, during this data gap, more than 40% of these users decreased or ceased their use of Landsat imagery. Close to 30% of Landsat 5 users felt their work had decreased in quality and scope, just over a quarter said their work was more time consuming, and 18% said their work was more expensive. Given that Landsat 7 was still providing new imagery during this time period (albeit with some missing data) and the entire archive of Landsat was still available, the impacts of the loss of new Landsat 5 data for a short period of time appeared substantial for some users. The results of the survey show that Landsat imagery was valued highly by these users. The value of Landsat will most likely increase as the free and open data policy becomes even more widely known, the new imagery from Landsat 8 begins to be used, and emerging issues facing the nation and the world, such as climate change, become more pronounced and require increasing amounts of reliable global-scale data.

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Chapter 14 Special Topics: Conservation Banking

The U.S. Endangered Species Act (ESA) prohibits "take" of fish and wildlife species officially listed as endangered or threatened, but can permit otherwise lawful activities that violate these prohibitions through Section 7(a)(2), for federal agencies, and Section 10(a)(1)(B), for private entities. The implementation of ESA Sections 7(a)(2) and 10(a)(1)(B) create the need for mitigation to offset impacts to listed species and their habitat (Ruhl 2005). Several different mitigation options are available to federal applicants and project proponents including implementing their own mitigation (often referred to as permittee responsible mitigation), paying into an in-lieu fee program, or the purchase of credits from a conservation bank.

The U.S. Fish and Wildlife Service (USFWS) describes conservation banks as permanently protected lands that contain natural resource values, which are conserved and permanently managed for species that are listed as endangered, threatened, candidates for listing as endangered or threatened, or are otherwise species-at-risk (USFWS 2012). Conservation banking is a market-based program that provides "credits" to landowners that undertake conservation activities, which they may then sell to parties that need to mitigate unavoidable impacts to a species. A credit is a defined unit of trade related to habitat or species of interest at the bank site. A credit may be equivalent to: (1) an acre of habitat for a particular species; (2) the amount of habitat required to support a breeding pair; (3) a wetland unit along with its supporting uplands; or (4) some other measure of habitat or its value to the listed species.[94] The number of credits associated with a particular conservation bank is determined by the USFWS and is a function of habitat condition, size and location of the parcel, and other factors.

The USFWS began approving banks for a number of federally listed species in the early 1990s in cooperation with other federal agencies or the State of California. Banks may be located on state and local government, private, or tribal lands; federal lands can be considered, but must be reviewed by the USFWS for applicability for mitigation and consistency with other regulations and policies. Banks located on federal lands are generally single-user banks established by an agency for its own use. Bankers can be corporations, individuals, companies, utilities, government agencies, non-profit organizations, and land trusts (Mead 2008). Buyers of bank credits include private sector entities (e.g., individual property owners, housing developers, energy developers, and non-profits) as well as public sector entities (e.g., state highway departments) (Hudson 2007, Bauer 2004). Conservation banks may allow other uses, beyond species conservation, as long as they are compatible with the primary purpose for which they were created. A 2005 survey of 32 banks found that 66% of the banks surveyed allowed cattle grazing, hunting, biking, horseback riding, hiking, and fishing (Fox and Nino-Murcia 2005).

Although the USFWS has not issued any regulations for its conservation banking program, it did issue a guidance document titled "Guidance for the Establishment, Use, and Operation of Conservation Banks" on May 2, 2003. The guidance was intended to help USFWS personnel (1) evaluate the use of

[94] USFWS. 2012. Conservation Banking: Incentives for Stewardship. http://www.fws.gov/endangered/esa-library/pdf/conservation_banking.pdf.

conservation banks to meet the conservation needs of listed species; (2) fulfill the purposes of the ESA; and (3) provide consistency and predictability in the establishment, use, and operation of conservation banks.

Leon and Mead (2010) outline the steps for creating a conservation bank as follows:

- Contact the USFWS office with jurisdiction over the proposed bank to determine if there is a conservation banking program that covers its resources.
- Provide the information necessary for evaluating the property's eligibility. This will likely include biological survey results for certain species on the property, a title report to assess encumbrances, and other information.
- Begin developing a conservation bank agreement in cooperation with USFWS, and possibly other government agencies, if the proposal also includes credits for resources regulated by other agencies.
- Grant a perpetual conservation easement to an eligible organization.
- Develop an adaptive management plan for the long-term stewardship of the property.
- Fund an endowment to cover the long-term stewardship of the property, including monitoring and management of the site.
- Once all parties have agreed to the terms and conditions of the conservation bank agreement and the document is executed, USFWS will release the credits in accordance with the agreement.

The USFWS and the National Marine Fisheries Service (NMFS) regulate federal conservation banks in accordance with the ESA and guidelines prepared by both agencies. USFWS, with 105 approved banks in 10 states and Saipan (as of October 15, 2012), regulates terrestrial and freshwater species and some marine mammals. NMFS, with 5 approved banks in California and Washington, regulates marine and anadromous species (Moody 2012).

Approximately 65% (68 of 105) of USFWS-approved and operational conservation banks are located in California (11 more banks are sold-out) (Layne 2012). California has another five state conservation banks that are managed for state-protected species (Rambarran 2012). In 2006, seven state and federal agencies in California signed an MOU agreeing to collaboratively develop a standardized process for both mitigation and conservation banking. A revised MOU was signed in 2011, adding an eighth agency.

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Additional material on this topic will be available in the coming months.

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Chapter 15 Special Topics: Wildland Fire Economics Policy, Budget and Performance

This chapter focuses on the Department of the Interior's (DOI's) fire program and provides a background on economics, policy, budget and performance issues in fire program management. Four DOI Bureaus – Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), U.S. Fish and Wildlife Service (FWS), and National Park Service (NPS) – have wildland fire management responsibilities that they integrate into their stewardship missions. DOI's Office of Wildland Fire (OWF) develops Department-wide policies and allocates appropriated funds to the bureaus.

Fire policies and land management have evolved considerably over the last century to incorporate scientific and technological advances, changing management philosophies, and social values. Despite the advances, the literature reflects widespread concern that fire program initiatives do not adequately address the issues and are not cost effective. A literature review prepared by DOI's Office of Policy Analysis (2012) focused on six topics relevant to fire program management, and found the following:

Policy – Policy changes have been the norm for DOI's Wildland Fire Program. Implementing Congress's call (2012) to shift the emphasis of hazardous fuel reduction funding from the Wildland-Urban Interface to the highest priority projects and areas, will likely require time to fully implement. Intergovernmental cooperation in firefighting has improved significantly. However, legal, institutional, and fiscal issues remain.

DOI Budget Trends – DOI's annual obligations have fluctuated depending on the extent of wildland fires and other factors.

Performance Measures – Performance measures have evolved with changing policies. The number of annual performance measures for DOI's Wildland Fire Program has been reduced in recent years. The literature calls for improving performance measures to more effectively capture the intent of program goals and objectives.

Economic Analysis – Economists have played a key role in evaluating wildland fire programs' costs and benefits. This is likely to continue, as the 2012 Appropriations Act directed DOI "to complete an assessment of all Department Wildland Fire programs to determine the most cost effective and efficient means of providing comprehensive fire management services in support of Department and bureau missions."

Models – Recent advances in modeling show promise in reducing uncertainties related to fire behavior and fire effects, and in describing potential values at risk. Together these should help better understand and identify trade-offs associated with various decisions related to fire management.

Data Availability – While progress has been made, additional actions are needed to improve data quality, availability, and accessibility.

Figure 15-1 shows how DOI budgets have been allocated across several categories since 1999. Suppression activities represent a large and increasing share, exceeding one-third of the budget for the past five years. Figure 15-2 shows DOI-managed wildland acres burned since 1997 (both figures are based on DOI data). There is no significant trend in the data; fluctuations in the number of acres burned each year reflect factors such as short-term and long-term weather, fuel accumulations, infestations, etc. Figure 15-3 shows DOI wildland fire suppression costs since 1997. There is no significant trend in the data; suppression cost fluctuations reflect differences in fire locations and the values being protected: higher suppression costs are typically incurred for protecting more highly valued resources such as designated critical habitat, or developed campgrounds in National Parks. Suppression expenditures are generally lower (per acre) for fires located in remote areas with lower values at risk, while fires in the wildland-urban interface threatening lives and property result in higher suppression costs.

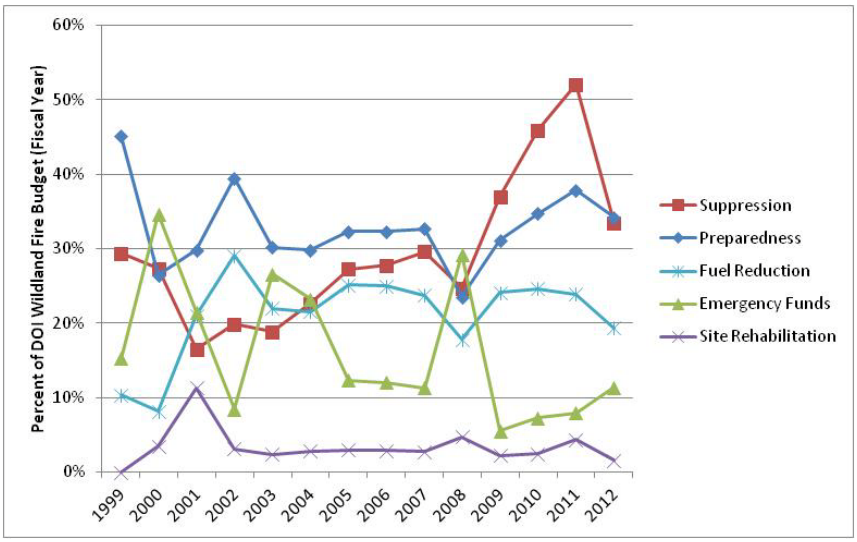

Figure 15-1. Interior Appropriations, 1999-2012 (CRS, 2011)

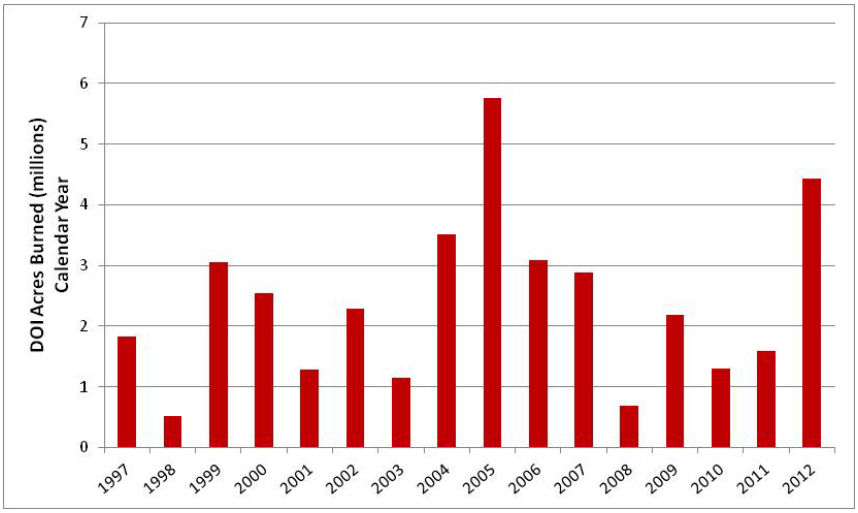

Figure 15-2. Annual DOI Wildfire Acres Burned, 1997-2012

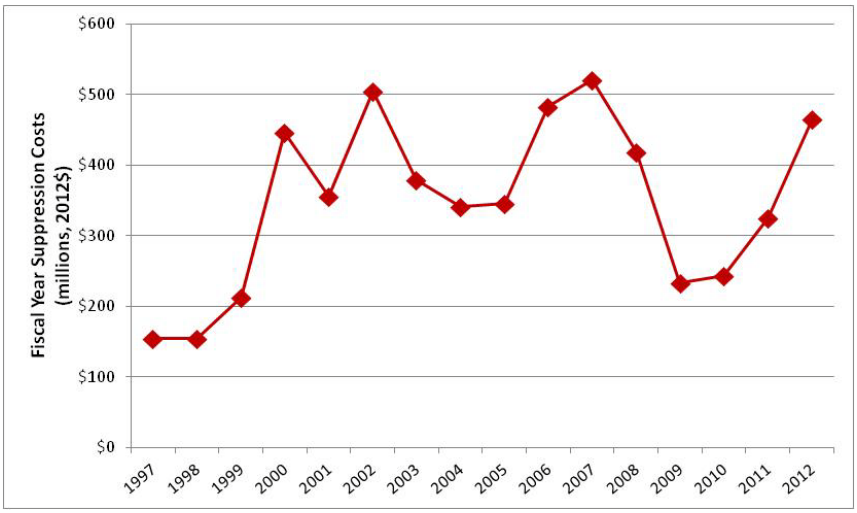

Figure 15-3. Annual DOI Wildfire Suppression Costs, 1997-2012

Source: DOI data.

The Strategic Issues Panel on Fire Suppression Costs (2004) found that 60% of total suppression obligations can be attributed to the largest 1% of wildland fires. Strauss et al. (1989) found that between 80 and 90% of wildfire acres burned in the Western U.S. are attributable to 1% of wildfires. More research may be able to illuminate a relationship between suppression costs and acres burned, which could in turn allow forecasts of acres at risk of burning to inform budget forecasts.

Focusing solely on direct expenditures related to avoiding and suppressing wildfire presents an incomplete description of social costs, which would ideally include values for all resources at their opportunity cost. One of the greatest challenges with comparing costs and benefits is in characterizing everything in terms of a common metric, such as dollars, especially as nonmarket goods and services often are difficult to quantify and monetize. Decision makers may never have comprehensive, succinct ledger entries to show the economic value of protecting resources like human health, cultural sites, and wildlife habitat. The evolving literature of benefit-cost analysis, cost effectiveness analysis, and highly valued resources constitutes a valuable source of information for decision makers concerning the tradeoffs they face.

For additional details on this topic see:
http://www.doi.gov/ppa/upload/Wildland_fire_literature_review_060812FINAL.pdf

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Chapter 16 Special Topics: Climate Change Adaptation

This chapter discusses the role of economic analysis and adaptive management (AM) in adaptation to climate change, from the perspective of the Department of the Interior's (DOI) land management responsibilities. The chapter also presents a simple model that illustrates some of the tradeoffs facing Interior's land managers as they consider habitat needs for endangered species in the context of climate change.

Background

Climate change has profound implications for resources managed by the Department of the Interior. Trends in climate-related environmental conditions, such as temperature, precipitation, frequency of extreme weather events, and sea level, directly affect our operations and achievement of our mission. The realities of climate change require the Department to integrate adaptation into our diverse operations, programs, plans, and policies. DOI must structure its management of natural and cultural resources as well as infrastructure to account for changing conditions and threats with respect to human and built assets; work with tribes in their adaptation efforts; and provide scientific information and tools to support the range of activities and programs we oversee in the face of climate change.

These realities require a number of choices in terms of the types of adaptation measures; the scale of implementation (local; regional); the timing of implementation (i.e., does it occur instantaneously as soon as it is first needed, or with some delay); and the specific geographic locations where such measures might be implemented. Choices concerning each of these issues have implications for costs as well as the extent to which adaptation offsets adverse impacts (e.g., how large its net benefits might be). Optimal choices are likely to vary by location and over time, as well as by type of impact and by affected entity. These are issues that are relevant both for on-the-ground projects, as well as in national and global contexts where trade-offs must be considered between the costs of climate policies and the residual damages resulting from climate change. A number of factors complicate any evaluation of adaptation choices:

- Adaptive management and climate adaptation both typically involve multiple entities and decision makers. In the context of the land management decisions facing the Department of the Interior this could imply the involvement of multiple bureaus, stakeholders, and tribal, state and local governments.
- Adaptive management in addition to most adaptation measures must be tailored to local circumstances.
- Institutions – public and private – play an important role in defining the decision making space, in allocating the costs and benefits of any particular adaptation response, and in the pace of decision making.
- The facts of climate change and potential adaptations are not known with certainty, nor are they likely to be agreed upon by all of the parties involved. This fact can influence both the timing and the nature of the actions that occur. The result is that errors in the selecting, timing and scaling of actions are likely. The errors can be in kind (choosing project A rather than project B) or in degree (too hasty or too tardy; too much or too little).

Adaptive management is a form of structured decision making that involves the use of management in the spirit of experimental science to improve management decisions. It calls for explicit identification of objectives and alternative management strategies, and for the involvement of stakeholders in decision making. Evaluating potential adaptation investments also may require identifying a set of climate scenarios. In fact, the choice of adaptation measures may actually depend, to a large extent, on the choice of climate scenarios. Adaptive management acknowledges uncertainties and can be adjusted as outcomes from management become better understood. The feedback between learning and decision making is a defining feature of adaptive management. The feedback between learning and decision making is a defining feature of adaptive management. This type of learning-based approach to natural resource management holds much promise for dealing with the challenges of adaptation to climate change.

Defining the Economic Problem:

The economic problem associated with climate adaptation can be formulated as a cost minimization problem, where society seeks to minimize the sum of adaptation costs and damages occurring as a result of climate change. This problem, which is really a dynamic problem that would seek to minimize the present value of adaptation costs and damages (or avoided damages), could also be defined for different regions or types of habitat (e.g., coastline or other types).

The solution to this problem, at least at a conceptual level, is to equate the marginal adaptation costs to the marginal benefit from avoiding the damage. This is easier said than done because there are a wide variety of alternative adaptation strategies, which could be implemented at different scales and intensities. Damages (or avoided costs) are associated with the loss of land or other resources (either due to sea level rise or other climate related changes that reduce productive capacity). Conceptually, the magnitude of the damages depends on the amount and value of land affected by climate change. The value of land depends on its opportunity cost and would include the value of any foregone ecosystem service flows. It is also possible that, over time, technological change may also result in less costly mitigation or adaptation approaches.

Adaptation, Environmental Markets, and Pricing

Flexible resource allocation is an important component of adaptation. Existing markets can offer a flexible mechanism provided the resources of interest (water, forests, etc.), and their ecosystem services are bought and sold at prices that reflect the full opportunity costs of the resource (full-cost pricing). Active markets exist for some resources, like water, though markets are limited or absent for many environmental goods and services. Government policy is an alternative for these areas, providing incentives for producers and consumers of ecosystem services.

Markets and full-cost pricing internalize the adaptation benefits provided by ecosystems, meaning that trade-offs affecting these resources take account of all the benefits they provide. Robust resource management decisions depend on this full accounting of costs and benefits. Given DOI's wide-ranging resource management responsibilities (including historic and cultural resources), it is in the Department's interest to facilitate the development of these markets and potentially participate as a buyer and seller of ecosystem services in some situations. For example, DOI could lease or purchase water for wetlands or purchase water from water banks to help meet instream flow needs for endangered or threatened species.

Markets for ecosystem services can play an important role in adaptation, providing mechanisms that enhance flexibility and resiliency. However, the success of ecosystem service markets depends on the ability to formalize transactions for services that are largely public goods. Examples of the use of markets include the following:

- Regulation requiring the purchase of environmental offsets for impacts to public resources (the impetus behind wetland mitigation banking)
- Voluntary transactions between a beneficiary of ecosystem services and a supplier (e.g., paying adjacent landowners to maintain trees benefitting pollinators); and
- Government purchases of ecosystem services on behalf of the public (e.g., paying upstream residents to modify land management practices to reduce urban runoff).

Many of these examples require a regulator to establish, enforce, and monitor trading rights. Thus, government rule-making has a strong influence on the market values that emerge. These markets also must be built around measurable and reliable ecosystem service indicators.

Climate change is anticipated to be accompanied by changing patterns and quantities of precipitation in the West (CBO, 2009). Western water markets should be of particular interest to DOI, given the increasing need for institutional flexibility in water management institutions, facilitating efficiency improvements, and in allocating limited supplies among uses and users. In general, markets, or market-like mechanisms (e.g., "water transfers," "water banking," or "voluntary water marketing") introduce flexibility into traditional water rights systems, bringing regional water users together in a collaborative trading setting. DOI has directly participated as a buyer/demander in some water markets (e.g., purchasing water for wetlands and instream flows).

Economic Analysis and the Evaluation of Adaptation Investments

The *DOI Adaptive Management Technical Guide (2009)* and its companion *DOI Adaptive Management Applications Guide* (2012) characterize adaptive management as a systematic approach for improving resource management by learning from management outcomes. Structured decision frameworks, such as adaptive management, can include processes for identifying trade-offs. With sufficient information, these tradeoffs can be valued as part of an economic analysis.[95] These tradeoffs could be identified via a process like structured decision making (discussed below) and integrated into a benefit-cost framework. "Soft" investments such as operational changes to existing facilities (e.g., dam and reservoir operations, harvest restrictions, etc.) are relatively easy to change and adjust in the face of new information. This type of investment may fit with an iterative learning-based approach, assuming that the relevant tradeoffs can be well specified. An example of these types of tradeoffs is a change in the timing of hydropower generation in order to increase instream flows during certain time of the year. "Hard" infrastructure investments require different evaluation with AM because the scale and scope of these investments are set at the outset and may be irreversible or expensive to adjust. A real options approach might be considered for irreversible infrastructure investments. This approach is attractive because it explicitly considers the implications of new knowledge becoming available over time. Otherwise, if incremental changes are possible, they might be evaluated using benefit-cost analysis.

[95] "Success" in the context of AM could be measured by the extent to which a given management change is associated with an increase in net economic benefits. Other criteria/metrics for evaluating the success of AM (e.g., stakeholder involvement, the extent to which progress is made toward achieving management objectives, the

Benefit-Cost Analysis

Decision makers seek to avoid committing public funds to outcomes that result in over-adaptation (overspending) or under-adaptation (and increased exposure to disaster risk).

For Interior the primary issue is identifying which investment decisions should be subject to benefit-cost analysis and then choosing the assumptions and methods used to undertake the analysis. As it is not feasible to evaluate every adaptation decision using benefit-cost analysis, the Department could focus on evaluating those involving "large" expenditures or sensitive resources. Some guiding principles might include:

- Establish a baseline, or "no-project" scenario;
- Value resources at their opportunity cost;
- Match the period of analysis to the life of the adaptation investment;
- Consider the effects of discounting; and
- Evaluate uncertainty and manage risks.

Additional Approaches

The use of additional methods may complement a benefit-cost approach. Some of these approaches could include:

- Real options analysis: Uncertainty in feasibility (environmental or technical) and economic conditions permeate the evaluation of climate change adaptation. Real options analysis provides a quantitative framework where the "option value" is determined as a function of the risk associated with the decision (Farrow 2004).
- Structured Decision Making Approaches – Multi-Criteria Analysis and Scenario Analysis "Multi-criteria analysis" (MCA), which involves comparing alternatives based on a set of pre-defined criteria (de Bruin, 2011) is another possible approach. The analyst examines the rate of return for the decision alternatives under the potential future states, identifying the alternative with the preferred outcome.
- Threshold Analysis: A disproportionate share of the damages from climate change arises from extreme events and occurs when key thresholds are crossed. A broad categorization of thresholds might consider ecological, utility, and decision thresholds.

Adaptation and Interior's Issues

Climate change adaptation in coastal zones

Each adaptation strategy is associated with different costs. Strategies and costs also vary across different coastlines. As a starting point, the tradeoff to be evaluated is between the costs of protection and the values associated with the land threatened by rising sea levels and other climate change-related impacts on coastal areas such as storm surge and sea ice retreat. Protective measures should be put in place as long as the benefits from avoided damages exceed the incremental costs of the protective

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extent to which results from monitoring and assessment actually improve management decisions, and whether implementation is consistent with applicable laws) are less amenable to measurement.

actions. To properly evaluate these tradeoffs, DOI would require an inventory of potentially impacted coastal assets, the extent to which they are vulnerable to climate change, cost estimates for the various strategies, and values associated with the vulnerable areas.[96]

Infrastructure

DOI manages a vast array of infrastructure, including: roads; bridges; buildings; and water treatment, storage, and distribution facilities. Changes to existing infrastructure are part of the adaptation response in many locations. Adaptation costs associated with infrastructure typically have two components (which are not mutually exclusive): costs associated with new infrastructure and costs associated with changes to existing infrastructure. Adapting infrastructure to changing climate conditions can be costly.

Conclusion

A challenge faced by DOI is how to prioritize among a large number of potential climate change adaptation projects, given that resources are limited and that the scope and magnitude of climate change in any particular location is uncertain. Priority-setting needs to account for the severity of potential climate impacts; uncertainty; the values of the systems, species, or populations; and the costs associated with any particular adaption measure or set of measures.

Additional material on this topic will be available in the coming months.

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[96] There is extensive information on adaptation costs for coastal regions worldwide, as well as on a global basis. However such cost estimates are typically only for coastal protection, and have traditionally been estimated only for a 1-meter sea level rise (OECD 2008). These costs are often quite high, with the exception being countries or regions where coastal land values are low (usually because of lower population densities) and where lower protection levels might be optimal. The cost estimates are usually based on models that seek to minimize the costs of protection and the residual (unprotected) damages that will be incurred through loss of land and natural habitats. The benefits in this case are the damages avoided as a result of protection. In regions with extremely valuable assets, "total" protection might indeed be optimal. In other cases, the optimal strategy might well be to invest in partial (or incomplete) protection and accept a certain amount of residual damage.

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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.

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Appendix 2. State-by-State Information

Table A2-1. State-by-State breakdown of value added supported by Interior activities, by sector

State	Recreation -- Value Added[1,2]	Energy & Minerals -- Value Added[2,3]	Grazing & Timber -- Value Added [2,4]	Major Grants & Payments -- Value Added[5]	DOI Salary -- Value Added[6]	Total[7]
			(billions, $2012)			
Alabama	0.04	1.43	0.00	0.10	0.01	1.59
Alaska	0.37	0.42	0.00	0.13	0.09	1.02
Arizona	1.16	0.39	0.00	0.08	0.18	1.80
Arkansas	0.12	0.38	0.00	0.03	0.01	0.53
California	2.49	5.61	0.01	0.29	0.37	8.76
Colorado	0.91	5.17	0.01	0.25	0.31	6.65
Connecticut	0.00	0.31	0.00	0.01	0.00	0.33
Delaware	0.00	0.05	0.00	0.01	0.00	0.07
District of Columbia	0.74	0.20	0.00	0.00	0.05	0.99
Florida	0.82	2.32	0.00	0.04	0.06	3.24
Georgia	0.23	0.59	0.00	0.02	0.05	0.89
Hawai`i	0.27	0.12	0.00	0.01	0.02	0.42
Idaho	0.29	0.28	0.01	0.05	0.06	0.68
Illinois	0.05	1.13	0.00	0.06	0.01	1.24
Indiana	0.05	0.64	0.00	0.03	0.01	0.73
Iowa	0.04	0.25	0.00	0.02	0.00	0.31
Kansas	0.04	0.43	0.00	0.02	0.01	0.50
Kentucky	0.07	0.39	0.00	0.08	0.01	0.54
Louisiana	0.04	10.47	0.00	0.33	0.04	10.88
Maine	0.18	0.09	0.00	0.01	0.01	0.29
Maryland	0.14	0.49	0.00	0.01	0.03	0.67
Massachusetts	0.37	0.68	0.00	0.01	0.06	1.11
Michigan	0.15	0.78	0.00	0.04	0.02	1.00
Minnesota	0.08	0.44	0.00	0.04	0.04	0.59
Mississippi	0.10	0.98	0.00	0.07	0.01	1.16
Missouri	0.15	0.49	0.00	0.03	0.03	0.70
Montana	0.43	1.09	0.02	0.12	0.06	1.70
Nebraska	0.03	0.13	0.00	0.01	0.01	0.19
Nevada	0.46	0.16	0.00	0.06	0.07	0.75
New Hampshire	0.00	0.10	0.00	0.01	0.00	0.12
New Jersey	0.16	0.61	0.00	0.01	0.02	0.80
New Mexico	0.24	10.20	0.00	0.59	0.13	11.15

State	Recreation -- Value Added[1,2]	Energy & Minerals -- Value Added[2,3]	Grazing & Timber -- Value Added [2,4]	Major Grants & Payments -- Value Added[5]	DOI Salary -- Value Added[6]	Total[7]
New York	0.39	1.43	0.00	0.03	0.05	1.89
North Carolina	0.65	0.61	0.00	0.03	0.02	1.32
North Dakota	0.05	4.69	0.00	0.08	0.02	4.85
Ohio	0.05	1.18	0.00	0.04	0.01	1.29
Oklahoma	0.10	1.59	0.00	0.03	0.03	1.75
Oregon	0.65	0.24	0.21	0.04	0.12	1.14
Pennsylvania	0.31	1.55	0.00	0.12	0.05	2.03
Rhode Island	0.02	0.23	0.00	0.01	0.00	0.26
South Carolina	0.07	0.36	0.00	0.01	0.01	0.45
South Dakota	0.13	0.11	0.00	0.02	0.04	0.30
Tennessee	0.49	0.46	0.00	0.03	0.03	1.00
Texas	0.22	20.62	0.00	0.23	0.05	21.12
Utah	0.95	6.60	0.00	0.27	0.07	7.89
Vermont	0.00	0.04	0.00	0.01	0.00	0.06
Virginia	0.52	0.85	0.00	0.04	0.18	1.60
Washington	0.36	0.48	0.00	0.04	0.10	0.99
West Virginia	0.04	0.22	0.00	0.08	0.02	0.36
Wisconsin	0.07	0.52	0.00	0.03	0.03	0.65
Wyoming	0.19	15.02	0.00	1.10	0.04	16.36

[1] Recreation contributions are based on visitor spending at units managed by BLM, BOR, FWS and NPS.

[2] BLM's Eastern States are not included in these totals due to lack of state-specific information. Information for Federal locatable (hardrock) mineral production is available only for Nevada; the figures reported here are based on estimates for all States, and likely under-report contributions for Nevada. Non-energy minerals in Arizona reflect estimates based on FY11 resource use.

[3] Energy & Minerals contributions are based on activities related to onshore and offshore oil and gas, coal, non-metallic minerals; and geothermal, wind, and solar electricity generation.

[4] Timber contributions are based on the value of timber harvested on BLM lands in 2012. Grazing contributions are based on a state-specific estimate of jobs supported per 1,000 animal unit months (AUMs).

[5] Grants and Payments contributions are based on Mineral Revenue Payments, PILT, AML, and certain other grants (Sport Fish, Wildlife Restoration, State and Tribal Wildlife Grants, LWCF with GOMESA, Historic Preservation, CIAP, CESCF, NPS Grants, and Refuge Revenue Sharing).

[6] DOI salary contributions are those supported by DOI employees spending their salary.

[7] Totals represent contributions supported by recreation, energy, minerals, grazing, timber, salaries and grants and payments in each of the 50 States. Contributions reported in Table 2-2 were estimated using a national-level model that includes interstate “leakages” not captured in state by state-level models. Therefore, the sum of state totals will not equal the national total.

Table A2-2. State-by-State breakdown of total output supported by Interior activities, by sector

State	Recreation -- Total Output[1,2]	Energy & Minerals -- Total Output[2,3]	Grazing & Timber -- Total Output[2,4]	Major Grants & Payments -- Total Output[5]	DOI Salary -- Total Output[6]	Total[7]
			(billions, $2012)			
Alabama	0.07	2.97	0.00	0.16	0.02	3.22
Alaska	0.63	0.78	0.00	0.19	0.14	1.74
Arizona	1.88	1.11	0.05	0.11	0.28	3.44
Arkansas	0.21	0.86	0.00	0.04	0.02	1.12
California	4.38	13.22	0.10	0.41	0.60	18.72
Colorado	1.51	8.02	0.12	0.36	0.49	10.50
Connecticut	0.00	0.84	0.00	0.01	0.00	0.86
Delaware	0.01	0.15	0.00	0.01	0.00	0.16
District of Columbia	1.15	0.68	0.00	0.00	0.07	1.91
Florida	1.35	5.42	0.00	0.05	0.09	6.92
Georgia	0.38	1.61	0.00	0.03	0.07	2.10
Hawai`i	0.48	0.38	0.00	0.01	0.03	0.90
Idaho	0.52	0.55	0.31	0.07	0.10	1.55
Illinois	0.08	2.81	0.00	0.09	0.02	3.00
Indiana	0.09	1.59	0.00	0.05	0.02	1.74
Iowa	0.07	0.64	0.00	0.02	0.01	0.74
Kansas	0.06	1.00	0.00	0.03	0.02	1.11
Kentucky	0.12	1.03	0.00	0.12	0.02	1.29
Louisiana	0.08	18.63	0.00	0.47	0.06	19.25
Maine	0.29	0.24	0.00	0.01	0.02	0.57
Maryland	0.22	1.47	0.00	0.02	0.05	1.76
Massachusetts	0.63	1.78	0.00	0.01	0.08	2.50
Michigan	0.26	2.01	0.00	0.05	0.04	2.36
Minnesota	0.15	1.09	0.00	0.05	0.06	1.35
Mississippi	0.19	2.05	0.00	0.10	0.02	2.36
Missouri	0.26	1.32	0.00	0.05	0.04	1.68
Montana	0.74	1.69	0.24	0.17	0.10	2.94
Nebraska	0.06	0.34	0.00	0.02	0.02	0.44
Nevada	0.75	0.73	0.15	0.08	0.11	1.82
New Hampshire	0.01	0.26	0.00	0.01	0.01	0.29
New Jersey	0.27	1.61	0.00	0.01	0.03	1.93
New Mexico	0.41	15.13	0.19	0.83	0.20	16.77
New York	0.61	3.84	0.00	0.04	0.07	4.55
North Carolina	1.11	1.65	0.00	0.04	0.04	2.85
North Dakota	0.08	6.69	0.00	0.12	0.04	6.93

State	Recreation -- Total Output[1,2]	Energy & Minerals -- Total Output[2,3]	Grazing & Timber -- Total Output[2,4]	Major Grants & Payments -- Total Output[5]	DOI Salary -- Total Output[6]	Total[7]
Ohio	0.09	2.86	0.00	0.07	0.02	3.04
Oklahoma	0.18	2.95	0.00	0.05	0.05	3.23
Oregon	1.14	0.65	0.66	0.06	0.19	2.72
Pennsylvania	0.54	3.69	0.00	0.19	0.08	4.50
Rhode Island	0.03	0.46	0.00	0.01	0.00	0.50
South Carolina	0.11	0.96	0.00	0.02	0.01	1.10
South Dakota	0.23	0.25	0.02	0.03	0.06	0.59
Tennessee	0.84	1.27	0.00	0.04	0.04	2.20
Texas	0.39	34.01	0.00	0.33	0.08	34.82
Utah	1.65	9.79	0.13	0.39	0.12	12.09
Vermont	0.00	0.12	0.00	0.01	0.00	0.14
Virginia	0.87	2.54	0.00	0.06	0.29	3.75
Washington	0.66	1.29	0.02	0.06	0.16	2.18
West Virginia	0.07	0.51	0.00	0.13	0.03	0.75
Wisconsin	0.11	1.35	0.00	0.05	0.05	1.55
Wyoming	1.01	21.98	0.18	1.55	0.07	24.79

[1] Recreation contributions are based on visitor spending at units managed by BLM, BOR, FWS and NPS.

[2] BLM's Eastern States are not included in these totals due to lack of state-specific information. Information for Federal locatable (hardrock) mineral production is available only for Nevada; the figures reported here are based on estimates for all States, and likely under-report contributions for Nevada. Non-energy minerals in Arizona reflect estimates based on FY11 resource use.

[3] Energy & Minerals contributions are based on activities related to onshore and offshore oil and gas, coal, non-metallic minerals; and geothermal, wind, and solar electricity generation.

[4] Timber contributions are based on the value of timber harvested on BLM lands in 2012. Grazing contributions are based on a state-specific estimate of jobs supported per 1,000 animal unit months (AUMs).

[5] Grants and Payments contributions are based on Mineral Revenue Payments, PILT, AML, and certain other grants (Sport Fish, Wildlife Restoration, State and Tribal Wildlife Grants, LWCF with GOMESA, Historic Preservation, CIAP, CESCF, NPS Grants, and Refuge Revenue Sharing).

[6] DOI salary contributions are those supported by DOI employees spending their salary.

[7] Totals represent contributions supported by recreation, energy, minerals, grazing, timber, salaries and grants and payments in each of the 50 States. Contributions reported in Table 2-2 were estimated using a national-level model that includes interstate "leakages" not captured in state by state-level models. Therefore, the sum of state totals will not equal the national total.

Table A2-3. State-by-State breakdown of total jobs supported by Interior activities, by sector

State	Recreation[1,2]	Energy & Minerals[2,3]	Grazing & Timber[2,4]	Major Grants & Payments[5]	DOI Salary[6]	Total[7]
			(jobs)			
Alabama	945	19,751	0	1,231	127	22,054
Alaska	7,121	4,241	1	1,655	1,103	14,121
Arizona	20,535	6,156	879	1,055	2,339	30,964
Arkansas	3,009	4,945	0	508	150	8,613
California	35,600	70,090	725	3,106	4,029	113,550
Colorado	14,913	37,452	985	3,403	3,844	60,597
Connecticut	25	4,703	0	137	30	4,896
Delaware	67	821	0	117	14	1,019
District of Columbia	9,697	3,656	0	44	455	13,852
Florida	14,243	34,510	0	609	784	50,146
Georgia	4,410	8,942	0	493	605	14,450
Hawai`i	4,474	2,063	0	172	232	6,941
Idaho	6,636	3,413	3,116	831	994	14,989
Illinois	754	15,802	0	673	139	17,368
Indiana	1,138	8,831	0	501	143	10,613
Iowa	905	3,624	0	269	69	4,868
Kansas	769	5,960	0	329	178	7,237
Kentucky	1,511	5,729	0	1,182	151	8,571
Louisiana	919	130,854	0	4,733	575	137,081
Maine	2,796	1,374	0	253	143	4,565
Maryland	2,374	8,078	0	217	393	11,063
Massachusetts	8,062	9,902	0	222	580	18,766
Michigan	3,001	11,318	0	609	328	15,254
Minnesota	1,608	6,178	0	595	489	8,871
Mississippi	2,544	14,350	0	1,309	197	18,399
Missouri	3,218	7,367	0	539	392	11,516
Montana	9,540	9,042	2,468	1,933	1,004	23,986
Nebraska	804	1,919	1	239	234	3,198
Nevada	7,362	4,091	1,455	685	920	14,513
New Hampshire	59	1,493	0	158	53	1,763
New Jersey	2,617	9,088	0	164	191	12,060
New Mexico	5,095	86,046	2,655	9,260	1,919	104,975
New York	5,751	21,437	0	354	456	27,997
North Carolina	13,717	9,255	0	491	349	23,812
North Dakota	1,145	31,784	15	1,594	379	34,916
Ohio	1,171	16,114	0	634	205	18,124
Oklahoma	2,113	17,165	0	545	459	20,282

State	Recreation[1,2]	Energy & Minerals[2,3]	Grazing & Timber[2,4]	Major Grants & Payments[5]	DOI Salary[6]	Total[7]
Oregon	12,205	3,706	4,828	744	1,689	23,171
Pennsylvania	6,030	21,072	0	1,557	619	29,278
Rhode Island	283	2,989	0	115	23	3,410
South Carolina	1,433	5,320	0	309	126	7,189
South Dakota	3,475	1,480	231	372	576	6,133
Tennessee	9,609	7,046	0	477	356	17,488
Texas	3,867	198,114	0	3,151	611	205,743
Utah	18,753	49,405	1,801	4,241	1,156	75,356
Vermont	54	680	0	145	41	921
Virginia	10,077	13,961	0	1,109	2,263	27,410
Washington	6,304	7,256	155	709	1,200	15,624
West Virginia	967	2,998	0	1,174	315	5,455
Wisconsin	1,438	7,557	0	526	412	9,933
Wyoming	13,200	95,249	1,627	17,240	609	127,927

[1] Recreation contributions are based on visitor spending at units managed by BLM, BOR, FWS and NPS.

[2] BLM's Eastern States are not included in these totals due to lack of state-specific information. Information for Federal locatable (hardrock) mineral production is available only for Nevada; the figures reported here are based on estimates for all States, and likely under-report contributions for Nevada. Non-energy minerals in Arizona reflect estimates based on FY11 resource use.

[3] Energy & Minerals contributions are based on activities related to onshore and offshore oil and gas, coal, non-metallic minerals; and geothermal, wind, and solar electricity generation.

[4] Timber contributions are based on the value of timber harvested on BLM lands in 2012. Grazing contributions are based on a state-specific estimate of jobs supported per 1,000 animal unit months (AUMs).

[5] Grants and Payments contributions are based on Mineral Revenue Payments, PILT, AML, and certain other grants (Sport Fish, Wildlife Restoration, State and Tribal Wildlife Grants, LWCF with GOMESA, Historic Preservation, CIAP, CESCF, NPS Grants, and Refuge Revenue Sharing).

[6] DOI salary contributions are those supported by DOI employees spending their salary.

[7] Totals represent contributions supported by recreation, energy, minerals, grazing, timber, salaries and grants and payments in each of the 50 States. Contributions reported in Table 2-2 were estimated using a national-level model that includes interstate “leakages” not captured in state by state-level models. Therefore, the sum of state totals will not equal the national total.

Appendix 3. Technical Appendix

General

- Estimated DOI Inputs as a Percent of National Sector – DOI contributions as a percentage of the entire industry at the national level. In general we assume that contributions are proportional to production. Thus if Interior lands produce a certain percentage of the national total for given resource, this is equivalent to that same percentage of the national output, employment and value added associated with that resource. For hydropower, wind power, and geothermal the percentage represents the DOI capacity as a percentage of total capacity.
- The value added and economic contribution estimates do not capture output or employment effects beyond payroll spending and natural resource production. Bureaus are engaged in various other activities funded by appropriations, e.g., land acquisition, BLM's mine land reclamation, construction, road building, education, etc.

OSM

- The majority of the Office of Surface Mining's activities related to reclamation of abandoned mine lands are encompassed by funding from the AML fund. The impact of these funds is captured in the entry for Grants and Programs reported earlier in the table.

Indian Affairs, BIA, and BIE

- Sales volumes and values for BIA's oil, gas and coal activities are based on data from ONRR. Lacking multipliers specific to oil, gas and coal activities on Reservations, we used a multiplier based on BLM's onshore oil, gas and coal activities at the national level.
- "Other Royalties" includes revenues reported as contract settlement payments, estimated royalty payments, tax credits, tax reimbursement payments, revenues reported under royalty-bearing transaction codes for non-oil, gas, coal, or natural gas liquid product codes. This includes revenue associated with contract settlement payments, and sand & gravel royalty payments. There are no sales volumes associated with the first grouping of Other Royalties.
- BIA's economic contributions from oil, gas, and coal are assumed to be proportional to BLM's.
- Drilling costs for oil, gas, and dry wells were calculated for each state where Indian wells were completed in FY 2011. Costs per well were calculated as the total costs for each type of well (oil, gas, or dry) divided by the total number of completed wells of each type. The data were taken from "The Oil & Gas Producing Industry in Your State" (IPAA, October 2012).
- The ratio of dry holes to total wells completed was calculated for each state where Indian wells were drilled. These results were used to estimate the number of dry holes associated with Indian wells completed in each state.
- A single entry is provided for BIA timber and grazing activities; to date, no grazing data were provided.
- "Other minerals" were assumed to be construction aggregate (sand and gravel; crushed stone). The value of output was estimated by assuming the 2012 royalty collections of $3.4 million were derived from a 5% royalty. This implies a commodity value of about $67 million. The total value of construction aggregates produced in the US in 2012 was $6.4 billion (source: Sand and Gravel (Construction), U.S. Geological Survey, Mineral Commodity Summaries, January 2013).

- The values reported for Irrigation represent the value of the crops produced using irrigation water supplied by BIA. This value overstates the actual production attributable to BIA, as some level of production would occur without the irrigation water delivered by BIA, and water is only one of many inputs into agricultural production.
- Economic contributions associated with contractual support provided to tribal governments were evaluated by applying state and local government multipliers.
- Irrigation: The Department of the Interior's Bureau of Indian Affairs (BIA) manages 17 irrigation projects on Indian reservations in the western United States. The overall approach for estimating economic contributions and employment estimates is similar to that used for Reclamation's irrigation activities. Economic contributions and employment estimates were estimated for agricultural activities associated with BIA operated irrigation projects using data from the USDA National Agricultural Statistics Service (NASS) 2007 Census of Agriculture, Volume 2, American Indian Reservations. The Census of Agriculture does not provide complete coverage of all reservations. Where information was not available from the Census of Agriculture, irrigated acreage information was from "Numerous Issues Need to Be Addressed to Improve Project Management and Financial Sustainability," GAO-06-314, Mar 27, 2006. Irrigated acreage data were combined with average crop revenue per acre for irrigated acreage calculated based on data in the 2007 Agricultural Census. The agricultural revenue values in the Census were indexed to 2011 dollars using the NASS food grain prices received index. The multipliers used were based on IMPLAN grain farming sector.

BLM

- The method used by BLM to estimate the contributions from oil and gas activities is based on adjusting the sum of the value of the gross output plus drilling costs to remove inter-industry sales to derive a final demand figure. A multiplier is then applied to final demand to derive the contribution estimates. The rationale for adding drilling costs to the gross output value (prior to making an adjustment to derive final demand) is that drilling costs are not accounted for in the IMPLAN production function for oil and gas extraction. Note that BLM's results are developed independently of BOEMRE's figures for offshore production, using a different approach. This complicates a direct comparison between the onshore and offshore analyses. BLM considers onshore direct output to include 1) oil and gas well drilling, with costs taken from the Independent Petroleum Producers Association report *IPAA Oil & Gas Producing Industry in Your State*; and 2) oil and gas sales, based on sales volume and sales value for the fiscal year. Final demand is taken to be the sum of these two items less interindustry sales.
- Figures reported for hardrock/locatable minerals were developed by the Office of Policy Analysis, assuming a total sales value of U.S. hardrock and other locatable minerals production of $40.1 billion (USGS Mineral Commodity Summaries 2013) and 13 total jobs (direct, indirect and induced) per $1 million, a value added multiplier of 1.54, and an output multiplier of 2.47 from IMPLAN Sector 27 "Mining and quarrying other nonmetallic minerals." In addition, we use estimated federal percentages for each mineral type to find individual federal sales value estimates (percentages from DOI (1993) "Economic Implications of a Royalty system for Hardrock Minerals" Appendix 13).
- The minerals included in the locatables category were as follows: barite, beryllium, bentonite, Fuller's earth, kaolin, copper, diatomite, feldspar, gemstones, gold, iron ore, lead, mica, molybdenum, nickel, perlite, platinum, salt, sand, silica, silver, sulfur, talc, and zinc. Non metallic minerals included gypsum, pumice, and crushed rock.

- Economic contributions associated with locatable minerals are not included in the state-level summaries because sufficient information was not available to apportion the contributions among the states.
- The methodology used to estimate the economic contributions associated with public lands grazing focuses on a specific subset of livestock to better reflect the animals that actually graze on BLM lands and also accounts for individuals who are unpaid or family laborers. In some areas this accounts for up to 35% of the total labor on ranches and farms. That figure was derived by developing a ratio between paid and unpaid/self-employed individuals for each of the relevant states. This methodology more accurately reflects the economic contribution that grazing on public lands makes to the ranching sector more generally. The analysis assumes that the grazing operations included in the Census of Agriculture are representative of those using BLM forage. It is possible that ranchers utilizing public lands have different spending or employment patterns than grazing operations as a whole, but using the Census of Agriculture provides a standard dataset for comparison across states. In addition, because the Census of Agriculture is only available every five years it is assumed that the per 1,000 AUM calculation remains constant from year-to year. It is also assumed that the ratio of paid to unpaid and self-employed labor is constant across all agriculture and forestry sectors. The sales value of BLM forage is based on the total sale price of livestock times the proportion of animal-unit months grazed on BLM-managed lands to total animal-unit months.
- Timber value is composed of the sales receipts for harvested sawtimber, sales of Special Forest Products, and stewardship timber sales. Contracts for sawtimber are typically sold at auction, and the BLM receives the agreed payments when timber is actually cut and sold. Special Forest Products includes fuelwood, posts, poles, etc. While the sales are negotiated, the BLM tries to follow the stipulation that sale prices will not go below 10% of the estimated market value. Stewardship Program timber sales are associated with BLM bartering goods (timber products) for services (land treatments) done outside contractors. The product value is used to offset the total cost of service work in the contract.
- Contributions related to building and operating wind and solar energy projects were derived using the Jobs and Development Economic Impact (JEDI) models produced by the National Renewable Energy Laboratory (NREL).

Reclamation

- FWS trip-related multipliers and average visitor expenditures were used to estimate impacts for Reclamation's recreation activities. The analysis relies on Reclamation visitation data collected during 2010-2012 and applies current expenditures per day, value added, output, and employment multipliers from FWS.
- The values reported for irrigation represent the gross value of the crops produced using irrigation water supplied by Reclamation. This value considerably overstates the actual production attributable to Reclamation, as some level of crop production would occur without the irrigation water delivered by Reclamation, and water is only one of many inputs into agricultural production. The multipliers used were developed for the 17-western state Reclamation service area. Reclamation is utilizing GIS imagery to document the type and acreage irrigated crops grown on Reclamation projects. These data, combined with state-level yields and nation-wide prices provided by the USDA, are used to estimate gross crop value. Reclamation currently has completed approximately 80% of this project.

- The economic contributions associated with Reclamation supplied M&I water are associated with the activities associated with operating water, sewage and other treatment and water delivery systems. The economic contribution delivering M&I water was estimated by using total 2005 M&I contract amounts in acre-feet and multiplying the total amounts by recent (2006) average market M&I water rates for major urban areas. For the FY 2012 report, no new information was available, so the FY2011 value was indexed using the CPI values for water, sewer, and trash collection services. Actual water deliveries are not reported on a Reclamation-wide basis. The most recent year for which actual M&I deliveries were reported on a Reclamation-wide basis is 1992. Therefore, these values should also be treated as estimates.
- The value of hydroelectricity generated at Reclamation facilities was estimated using regional wholesale prices for Reclamation major hydropower production areas as follows: BPA - $0.033/kWh; Parker Davis - $0.008/kWh; Boulder-Hoover - $0.021/kWh; Loveland - $0.041/KWh; Billings - $0.033/kWh; and Salt Lake City - $0.03/kWh.

BOEM and BSEE

- The BOEM maintains an in-house socio-economic impact model, MAG-PLAN, for economic impact analyses to support its lease sale planning duties. MAG-PLAN identifies the industry sectors that contribute to offshore oil and gas activity (e.g., wells drilled, platforms installed, etc.) and calculates the size of the direct impact in each sector. Total OCS related spending and employment in the U.S. economy is estimated with ratios and multipliers from the recently updated version of the MAG-PLAN model which incorporates 2010 IMPLAN data.
- BOEM's economic impact models and the macroeconomic allocation factors available from other agencies indicate that the activities associated with this production resulted in over $122 billion in the total U.S. output in FY 2012, over $59 billion in value added[105] (approximately 0.4% of total U.S. GDP) and sustained 734,000 domestic jobs (approximately 0.6% of all U.S. employment).[106] The rows in Table A3-1 identify the individual components that we estimated to arrive at these totals.

[105] Value added is defined as the difference between an industry's total output and the cost of its immediate inputs. It is an individual producer's contribution to GDP.

[106] These jobs are considered sustained because many are continued from OCS oil and gas activity in previous years. It should be emphasized that these estimates do not represent "new" jobs; many of these would represent new contracts or orders at existing firms that would essentially keep the firm operating at its existing level as earlier contracts are completed and filled.

- The basis for calculating the FY2012 impacts of OCS oil and gas activity is the sales value of FY2012 OCS oil and gas production as published by the Office of Natural Resources Revenue.[107] As shown in the first column of Table A3-1 , the sales value of OCS production in FY2012 was just under $60 billion.[108] Because different sources of spending generate different degrees of economic impact, we distributed this sales value among industry spending, government revenue, and after-tax profits to enable the calculation of total economic impact and individual state impacts. The portion of industry profits that flow to foreign entities has spending impacts that cannot be separated from those of other U.S. activities that generate income abroad, so we omit any spending impact from this portion of total sales.[109] That leaves just over $50 billion of OCS stimulated direct spending in the U.S. economy, shown in the second column of Table A3-1.

Table A3-1. BOEM and BSEE Administered Industry Economic Impact FY 2012

	OCS Oil, Gas, and NGL Sales Value ($ millions)	Resulting Direct Domestic Spending ($ millions)	Resulting Total Domestic Output ($ millions)	Resulting Total Domestic Value Added ($ millions)	Domestic Jobs Sustained (Thousands)
Industry Spending	**$23,907**	**$23,907**	**$53,938**	**$31,658**	**336**
Government Revenue	**$12,198**	**$12,198**	**$38,902**	**$10,525**	**206**
After-Tax Profits	**$23,663**	**$13,998**	**$29,493**	**$16,931**	**192**
Foreign After-Tax Profits	*$9,664*	*NA*	*NA*	*NA*	*NA*
Domestic After-Tax Profits	*$13,045*	*$13,045*	*$26,452*	*$15,610*	*176*
Tax on Dividends	*$953*	*$953*	*$3,041*	*$1,321*	*16*
Sales Value	**$59,768**	**$50,104**	**$122,333**	**$59,115**	**734**

NB: Totals may not sum due to rounding error

[107] http://statistics.onrr.gov/ReportTool.aspx

[108] Office of Natural Resource Revenue only reports the sales value of royalty bearing volumes of oil and gas. To calculate the total sales value, we used the effective price (the ratio of sales value to sales volume) of the revenue volumes and applied it to the non-revenue volumes. The effective price is $3.09/mcf for gas, $1.52/gal for NGL, and $109.14/bbl for oil.

[109] As described in the After-Tax Profits section and shown in Table 4, foreign revenues come from a portion of retained earnings that are spent overseas and dividends held by shareholders in the rest of the world.

- We assumed direct industry spending (i.e., capital and operating expenditures) was 40% of total sales value (0.4 * $59.768 billion) in FY2012.[110] We then applied MAG-PLAN multipliers for direct, indirect, and induced spending (a total multiplier of 2.26) to estimate the total domestic output associated with this direct spending of $23.907 billion. We used the industry spending ratio from MAG-PLAN of $1.32 value added for every dollar of direct spending, to derive a value added of $31.658 billion. In addition, we estimated jobs sustained by industry spending using the ratio from MAG-PLAN of 14.07 total jobs per million dollars of direct offshore oil and gas industry spending, resulting in a figure of 336,000 jobs sustained. These output and employment estimates are shown in the third, fourth, and fifth columns, first row, of Table A3-1 for industry spending.
- Government OCS revenue originates from leasing revenue and taxes. A portion of OCS leasing revenue is allocated to grant and revenue sharing programs including state sharing in the 8(g) zone, GOMESA, Land and Water Conservation Fund (LWCF) and the Historic Preservation Fund (HPF). The remaining 98 percent of leasing revenue and all of the tax revenue go into the Treasury General Fund. To calculate the total output from the spending of government revenues, we used the MAG-PLAN derived Federal government spending multiplier (based on IMPLAN data) of 3.19. We converted government spending to jobs using the IMPLAN ratio of 16.86 total jobs per million dollars of direct spending by the Federal government. Leasing and tax revenue are divided between states based on historical federal funds distributions.
- Estimated after-tax profits of $23.663 billion ($13.998 billion going to domestic entities and $9.664 billion going to foreign entities) were distributed for our analysis between retained earnings and dividends to shareholders using EIA data which indicates that retained earnings are roughly equal to 66% of after-tax profits in the oil and gas industry ($15.6 billion) and dividends are roughly equal to 34% ($8.5 billion). Splitting retained earnings this way treats funds that go to the rest of the world as a leakage from the economy that have no discernable direct spending impacts in the U.S. Moreover, the domestic retained earnings are either saved or are already included in industry spending, so we assigned no additional economic impact to retained earnings beyond the direct spending. As with foreign shares of retained earnings, we allocated a portion of total dividends to foreign shareholders. As with foreign shares of retained earnings, we allocated $8.045 billion from total dividends to foreign shareholders using data from the Bureau of Economic Analysis, Department of Commerce, which indicates 21% ($1.69 billion) are sent to shareholders in the rest of the world, and thus have no direct spending impacts. Of the $6.356 billion of dividends paid out domestically, we used the IRS dividend tax rate of 15% to calculate taxes of $0.953 billion. Of the after-tax domestic dividends ($5.4 billion), we assume, based on two empirical studies, that 25% ($1.351 billion) is reinvested and the remaining dividends ($4.052 billion) are spent by shareholders.
- Domestic retained earnings of $8.277 billion and domestic spending from reinvested dividends of $716 million total $8.993 billion to be divided between onshore and offshore operations. Using the EIA data on oil and gas expenditures, of the 53% of expenditures in the U.S., 73% are on onshore activities, and 27% are for offshore activities. The offshore expenditure impacts are calculated identically to the industry spending described earlier (with a direct to total output multiplier of 2.26). The onshore portion is calculated using the IMPLAN Sector 20 and 29 average multiplier of 1.98 for total spending, 12.92 jobs per million dollars spent, and $1.15 value added for every dollar spent. These calculations result in a total impact of $18.495 billion in total output, $10.725 billion in value added, and 119,000 jobs.

[110] This assumption is based on the results of BOEM's in-house leasing model, IMODEL.

- The tax revenue from dividends is treated in the same way as government revenues with an output multiplier of 3.19 and a ratio of total jobs to direct spending of 16.85, resulting in a total output of $3.041 billion, a total value added of $1,321 and total employment of 16,000. We based the total impact from the spending of domestic dividends ($7.957 billion) on the average (1.96) of the multipliers of the consumer sectors in IMPLAN (sectors 320-425). Likewise, we used the IMPLAN ratio of $0.41 in value added per dollar spent and 14.10 total jobs per million dollars of consumer spending to calculate the value added and employment, $16.931 and 57,000.
- Additional analysis was required to estimate the distribution of economic impacts by state. For the industry spending category, the MAG-PLAN model reports the economic impacts that occur in each of the five Gulf of Mexico (GOM) states while aggregating the remainder of the U.S. Since MAG-PLAN has the breakout of economic impact (direct spending, total output, and total jobs) for the GOM states, we applied the percentages for each individual state to the FY2012 industry spending data to calculate the impacts in each of the GOM states. For the remainder of the U.S., we used Bureau of Labor and Statistics (BLS) data on employment by state for each industry sector that MAG-PLAN identifies as having meaningful levels of activity (at least 1% of activity) outside the GOM states.[111] We weighted the BLS state employment data by the contribution of each sector to total industry spending from MAG-PLAN to give us the distribution of economic impacts from industry spending by state. Next, we allocated the spending outside the GOM states according to the new BLS-derived distribution.
- For the government revenue sector, we allocated the spending and job components of grant and revenue sharing programs to the state which receives the funds. We allocated the remaining leasing revenue and tax revenue between states in the proportion in which each receives government funds based on historical federal funds distributions to states as reported by the Census Bureau.[112]
- Note that BOEM's results are developed independently of BLM's figures for onshore production, using a different approach. This complicates a direct comparison between the offshore and onshore analyses. BOEM considers offshore direct output to include several related supporting sectors, including steel product manufacturing, water transportation, air transportation, food supply, etc. Interindustry sales are removed in calculating final demand.

Grants and Payments

- The total grants and payments reported in Table A1-1 represent all grants and payments for bureaus and Interior-wide programs in FY 2012, including current and permanent PILT payments and mineral revenue payments. State-level FY 2012 grants and payments data were obtained from the DOI Office of Budget for the grants and payments analyzed in this report. The FY 2014 Budget in Brief reports actual FY 2012 grants and payments totaling $4.856 billion.
- Includes a total of $4.91 billion in grants and payments. Variances between the two figures can be attributed to the use of estimates for certain grant and payment totals at the time the Budget in Brief is printed, and exclusion of program administration costs in grant awards.

[111] http://www.bls.gov/cew/

[112] U.S. Census Bureau Statistical Abstract Table 467: Federal Funds - - Summary Distribution by State and Island Areas: 2007. <http://www.census.gov/compendia/statab/2010/tables/10s0467.xls>.

- The national-level value added and economic contribution analysis of grants and payments displayed in Chapter 1 and Appendix 1. Economic Contribution Estimates use national-level multipliers for the appropriate sectors. The state-level analysis of employment impacts related to grants and payments included in Appendix 2. State-by-State Information only includes those categories for which state-level data were available. Including information on impacts of the full array of grant programs and payments would likely increase employment impacts. The state analysis uses state-level multipliers for the appropriate sectors for each grant category
- Energy and mineral leasing revenues (bonuses, rents, and royalties) disbursed to the U.S. Treasury are one of the Federal Government's largest sources of non-tax receipts. These revenues help fund various government functions and programs through the General Fund of the U.S. Treasury. Royalty payments are divided into offshore and onshore categories. All employment and output impacts for offshore royalties were included in the category of Energy and Minerals for the national and state-level analyses.
- Federal law requires that all monies derived from mineral leasing and production activities on Federal and American Indian lands be collected, properly accounted for, and distributed. For Federal onshore lands, the revenues are generally shared between the states in which the Federal lands are located and the Federal government. In the case of American Indian lands, all monies collected from mineral production are returned to the Indian Tribes or individual Indian mineral lease owners. Revenues associated with Federal offshore lands are distributed to several accounts of the U.S. Treasury and certain coastal states with special Federal offshore tracts adjacent to their seaward boundaries.
- Does not include $12 billion in leasing revenues and corporate taxes that flow to the Treasury as a result of Interior's offshore mineral activities. These revenues are included in the BOEM totals.
- States receive nearly 50 percent of the revenues associated with mineral production on Federal public lands within their borders. Alaska is the one exception, which receives a 90 percent share. Coastal states, with certain Federal offshore 8(g) tracts adjacent to their seaward boundaries, receive 27 percent of the revenues.
- Mineral revenue payments include receipts for sales in the National Petroleum Reserve – Alaska, Mineral Leasing Associated Payments, National Forest Fund Payments to States, and Payments to States from Lands Acquired for Flood Control, Navigation, and Allied Purposes.
- Grants and Payments includes mineral revenue payments to states associated with onshore production, and grant programs funded by offshore leasing and other sources of revenues.
- The state-level analysis includes a preliminary estimation of the impacts of Federal offshore royalty payments (to states via Treasury). Additional details on these calculations are included in the BOEM section above.

- Land acquisitions: Output and employment contribution estimates for land acquisition are derived using state and national-level multipliers. It is assumed that 90% of funds go to landowners and 10% are spent on transaction costs. Much of the money land owners receive is likely to go into savings, be used to pay off loans, or be subject to tax. It is therefore assumed that landowners will spend only 50% of funds they receive. These expenditures are modeled as a household income change for households with annual incomes greater than $150,000. The remaining 10% of funds are assumed to go to service providers associated with real estate transaction costs or monitoring and administration of easements. Specific services associated with land acquisition could include land appraisal, title examination and legal services, environmental site assessments, and ecological inventory and management planning. IMPLAN sector 374 (management, scientific, and technical consulting services) is used to model the services associated with land acquisition. Temporal issues complicate the analysis, as there may be a delay between the date of the purchase, the date the landowner receives the funds, and the dates the landowner spends the funds. Contributions are typically reported for one year, and only a small portion of the funds received by landowners is likely to be spent in that same year; monitoring expenditures will also often be incurred in perpetuity whereas transaction costs are all up-front. As a simplifying assumption, all landowner expenditures and service fees are assumed to occur in the same year that the transaction takes place.

Payroll Impacts

- The domestic jobs supported by Interior in Table A1-1 represent additional jobs above and beyond Interior employees.
- For Table A1-1, 2012 payroll data were obtained from Department of the Interior Human Resources data systems. The payroll data include salary data based on the duty-station of all Interior employees through pay period 17, 2012.
- The calculation of the economic contributions associated with DOI payroll adjusts the total value of payroll for each state to account for taxes and savings rates using state-level data. These disposable income values (payroll – savings and taxes) are then used to calculate the economic impacts. This differs from the method used in last year's report, in which disposable income was assumed to be 66% of the payroll values for all states.
- For the payroll contributions shown in Table A1-1 , a national multiplier was used to estimate the employment contributions of Interior payroll, equaling 11.1 jobs per $1 million.
- For state-level salary effects shown in Table A2-1 and Table A2-2, 2012 payroll data and state-level multipliers were used. Since state multipliers do not capture leakages, the total of state salary impacts will not equal the national-level salary employment impacts.
- The total salary paid and number of employees for each Bureau does not necessarily reflect FTE data typically reported in budget documents. These data were used to estimate total salary impacts rather than data on total FTE's, which would not have been a complete estimate of total salary impacts of DOI employees.
- Some DOI bureaus, such as NPS, report payroll impacts in separate publications such as "*Economic Benefits to Local Communities from National Park Visitation and Payroll, 2010.*" The payroll numbers presented in the NPS report differ somewhat from those in the DOI report due to the fact that DOI used Department-wide FY 2012 payroll data from the central human resources data system and used a different set of national-level multipliers.

Recreation Impacts

- In Chapter 2, the value of the national sector was taken to be $858 billion, the 2012 output of the travel and tourism industry, as measured by the direct output of goods and services sold directly to visitors (source: Bureau of Economic Analysis Travel and Tourism Satellite Accounts).[113]
- Total recreation economic and employment impacts are national estimates calculated using national level multipliers, which include "leakages" between states that are not captured in state-by-state models.
- Last year's report included data for NPS units in U.S. territories, but not for FWS units. This year's report does not include these areas in the economic analysis for NPS or FWS. Visitation data for NPS reported in Table 2-2 includes visitation for all NPS units including U.S. territories. FWS does maintain some visitation data for sites outside of the continental United States, Hawai`i, and Alaska, and future analysis could include these areas.
- Visitation and expenditure data sources included the following: FWS Fishing, Hunting, and Wildlife-Associated Recreation Survey; NPS visitor surveys, and unpublished data for FY 2011 from *Economic Benefits to Local Communities from National Park Visitation, 2011* (Cui et al. 2013) for site-level impacts of visitor spending; for BLM sites, Forest Service expenditure data were used; Reclamation expenditures were also based on the FWS Fishing, Hunting, and Wildlife-Associated Recreation survey. Spending profiles associated with these data sources were used to develop estimates of average expenditures. For BLM the assumptions that were used were based on *Spending Profiles of National Forest Visitors, NVUM Four Year Report* by Stynes and White, 1998.
- Reclamation recently revised the method they used to collect recreation visitation information and new data has been collected over the past two years. In most cases, project recreation sites are managed by Reclamation partners, including both Federal and non-Federal entities.
- FWS used 2008 IMPLAN data and FY2012 visitation numbers; NPS used 2009 IMPLAN data and calendar year 2011 visitation numbers.
- Calculations for NPS relied on a similar approach to what was used for as BLM, but visitor segment, average persons per party, and spending profiles were derived from NPS data sources. In addition the MGM2 generic multipliers were used instead of IMPLAN state-specific multipliers (2008 NPS MGM2 Report, http://web4.msue.msu.edu/mgm2/default.htm). NPS visitation and economic contribution data are from FY2011, the most recent year for which information was available.
- The FWS National Survey of Hunting, Fishing, and Wildlife Associated Recreation state-level data were used to determine the average recreationist's trip spending per day.
- The BOR and FWS recreation valued added figures are based on the ratio of NPS valued added to total output. The FWS valued added figure for Delaware is based on the average of the MD, NJ, PA, and VA ratios because Delaware does not have a NPS unit.
- Table A2-1, Table A2-2 and Table A2-3 present state-by-state summaries of the total economic impacts and employment related to recreation visits and other Interior activities.

[113] http://www.bea.gov/newsreleases/industry/tourism/2013/pdf/tour412.pdf.

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