


MANAGING OFFSHORE ENERGY AND OTHER MINERAL RESOURCES



Chapter 6 recommended development of a coordinated offshore management regime that would be comprehensive, transparent, and predictable, bring a fair return to the public, and promote a balance between economic and environmental considerations. The management of nonliving resources in federal waters raises many of the same fundamental policy questions. From the well developed, but politically contentious, outer Continental Shelf oil and gas program to new and emerging offshore uses that lack comprehensive management regimes, much can be learned. But much work also remains in developing a consistent system for unlocking the treasures of the sea while protecting the marine environment and providing affected parties a voice in decisions.

Exercising Jurisdiction over Nonliving Resources in Federal Waters

In addition to its responsibilities for living marine resources, the federal government also exercises jurisdiction over nonliving resources, energy and other minerals located in the waters and seabed of the more than 1.7 billion acres of the outer Continental Shelf (OCS). Offshore oil and gas development has the most mature and broadest management structure of all such resources. It also has the longest and richest history, characterized by major changes to the underlying law that established the more comprehensive administrative regime, as well as intense political conflict resulting from divisions among stakeholders and tensions inherent in American federalism. The development of other ocean energy resources—some of which are newly emerging technologies—have differing levels of management, but none are currently making any noteworthy contributions to domestic production numbers. Historically, there also have been varying expressions of commercial interest in non-energy minerals in the U.S. exclusive economic zone (EEZ), but only sand and gravel have been used in recent years by coastal states and communities, because of a change which eased access to those resources.

Managing Offshore Oil and Gas Resources

As noted in Chapter 2, from its beginning, the federal offshore oil and gas program faced controversy over ownership issues, as states unsuccessfully sued the federal government

over control of offshore waters. Once that issue was settled legislatively, there was a short but relatively stress-free period. Conflict, however, soon emerged over issues of management, environmental risks, and the costs and benefits of energy exploration and production on the OCS that continues to this day. Proponents point to the program's contributions to the nation's energy supplies and economy, significant improvements in its safety and environmental record, and noteworthy technological achievements. Opponents argue that offshore oil activities harm coastal communities economically and the marine environment unacceptably. The ongoing debate is carried out in the halls of Congress, federal agencies, state and local governments, trade associations, and nongovernmental organizations. OCS oil and gas development is a classic example of the politics of multiple-use resource management, including federal-state tensions, competing user issues, arguments over the interpretation of data, and disagreements concerning tolerable levels of risk.

Despite its political problems, which are best understood through an awareness of the historical context associated with it, today the OCS oil and gas program has a well institutionalized and reasonably comprehensive management regime. While not without its critics, the program seeks to balance the many competing interests involved in offshore energy activity, requires state and local government input in federal decisions, and specifies detailed procedures to be followed by those seeking offshore leases. It also manages the various processes associated with access to non-energy minerals on the OCS.

Energy development in federal waters is big business and has become an important part of the fabric of the U.S. ocean policy mix. Most observers agree that the federal OCS oil and gas program benefits America by helping to meet energy needs, creating thousands of jobs, and contributing billions of dollars to the U.S. Treasury. Despite the limited offshore geographic area from which production flows and in which leasing is authorized, the amount of oil and gas production from the OCS is significant. In 2002 and 2003, federal offshore waters produced more than 600 million barrels of oil annually¹ and about 4.5 trillion cubic feet of natural gas.²

From a Quiet Beginning to Prohibitions on Leasing

In 1953, Congress enacted the Submerged Lands Act, which codified coastal states' jurisdiction off their shores out to three nautical miles (or, for historic reasons, nine nautical miles for Texas and the Gulf coast of Florida). That same year, regulation of OCS oil and gas activity seaward of state submerged lands was vested in the Secretary of the Interior with the passage of the Outer Continental Shelf Lands Act (OCSLA), which established federal jurisdiction over the OCS for the purpose of mineral leasing. For a period of some fifteen years, the offshore energy program was relatively quiet, being confined largely to leasing off of Louisiana and Texas. In the late sixties, however, the relative peace on the OCS would be dramatically changed.

As discussed in Chapter 2, the 1969 Santa Barbara blowout took place during an era of rapidly expanding environmental awareness and helped spur the enactment of numerous major environmental laws, including the National Environmental Policy Act (NEPA), the Coastal Zone Management Act (CZMA), the Marine Mammal Protection Act (MMPA), and the Marine Protection, Research, and Sanctuaries Act (MPRSA).

Just as the nation's environmental consciousness rose, so too did recognition of the need for secure supplies of oil and gas. Also, as noted in Chapter 2, the 1973 Arab oil embargo prompted President Nixon to announce plans to lease 10 million OCS acres in 1975, an area equal to the entire amount leased prior to that time. Sales were scheduled not only in areas of earlier OCS activity, but also along the Atlantic and Pacific coasts. The result was a nationwide debate that raged through the remainder of the decade, pitting the oil and gas industry and its allies against various representatives of coastal states, commercial and sport fishing interests, and environmental organizations.

Congress responded to this debate by virtually rewriting the OCSLA in 1978, requiring the Secretary of the Interior to balance the nation's needs for energy with the protection of human, marine, and coastal environments, make certain that the concerns of coastal states and competing users were taken into account, and ensure that some of the newly enacted environmental laws were integrated into the OCS process. However, before regulations and procedures could be fully developed to support the amended law, in the early 1980s the Reagan administration proposed to terminate funding for the CZMA and its Coastal Energy Impact Program (CEIP). The CEIP was specifically designed during the debate over the OCSLA amendments to provide grants and loans to coastal states to deal with the environmental effects occasioned by OCS activities. At the same time these budget cuts were put forward, the Secretary of the Interior was pursuing an aggressive offshore program that would make one billion acres available for oil and gas leasing over the ensuing five years. Thus began the modern day version of the battle over offshore oil, one that has endured for over two decades and has included major legislative and executive branch negotiations, actions to restrict leasing in so-called "frontier" areas, Supreme Court cases, federal-state battles over administrative procedures and the sharing of revenues, and the buyback of some OCS leases by the federal government.

In its initial reaction to the proposed budget cuts, Congress was able to save the CZMA, but not the CEIP. It then turned its attention to restricting and ultimately prohibiting a substantial part of the OCS leasing schedule of the U.S. Department of the Interior (DOI). Using its appropriations process in 1982, Congress put four basins offshore northern California off limits to leasing. For the next few years, every annual DOI funding bill included leasing prohibitions on additional regions until practically all offshore planning areas outside of the Gulf of Mexico and Alaska were excluded.

Additionally, Presidents have expanded on congressional action, providing longer term restrictions than those covered in annual appropriations bills. In 1990, President Bush withdrew areas offshore California, southern Florida, the North Atlantic states, Washington, and Oregon from leasing consideration until after 2000. A few years later, the Clinton Administration added additional areas to the restricted list, extended all of the withdrawals until 2012, and included a permanent prohibition on leasing in national marine sanctuaries. These presidential and congressional actions have removed some 610 million acres from leasing consideration and effectively limited access to the OCS program to the central and western Gulf of Mexico (95 percent of offshore production), a small portion of the eastern Gulf, and virtually all areas off Alaska (Figure 24.1).

The OCS Leasing, Exploration, and Development Process

As already noted, the OCSLA is a relatively comprehensive resource management statute. Besides authorizing the Secretary of the Interior to hold competitive lease sales for offshore tracts, regulate and oversee lease activities, and encourage efficient, safe, and diligent production, the law specifies the steps potential lessees must take to bid on offshore tracts and the process that occurs after receiving a lease. For example, the OCSLA requires consultation with coastal states and localities at a number of points in the federal offshore decision-making process, including during the development of a five-year leasing program, individual lease sale delineations, exploration and development-production plans, and environmental studies and oil and gas information programs. Further, the law carries provisions on offshore safety regulations, citizen suits and judicial review, enforcement authority, the applicability of NEPA, geological and geophysical exploration, export limitations, documentation requirements for offshore vessels and rigs, and numerous opportunities to address other environmental issues.

DOI's Minerals Management Service (MMS) characterizes its administration of the OCSLA as being "process rich" (Figure 24.2). Through the initial years of promulgating regulations to implement the 1978 amendments, and through litigation about the mean-

Figure 24.1 Offshore Oil and Gas Leasing Has Been Limited to a Few Planning Areas



- Planning area boundaries
- Proposed for leasing in the MMS 2002–2007 leasing program
- Area withdrawn from leasing through 6/30/12
- Area neither withdrawn nor proposed for leasing

Shown above are the outer Continental Shelf planning areas in the Minerals Management Service's 2002–2007 leasing program. The entire West Coast and almost all of the East Coast have been restricted from leasing through 2012, leaving only areas of the central and western Gulf of Mexico (and a small area of the eastern Gulf) and virtually all areas off the Alaskan coast available for development.

Source: Minerals Management Service, Washington, DC.

ing of certain provisions, the current OCS leasing and development program is one that is, on balance, coherent and reasonably predictable. Although the comprehensiveness of the program has not precluded the political battles noted above nor avoided restrictions on leasing in frontier areas, in those regions of the nation where offshore development is accepted, the internal administrative process is well known and understood by those who invest in offshore leases and those who choose to observe and comment on such activity. The OCSLA is replete with references to the applicability of other statutes and the authority of other departments in the oil and gas process, and presents a clearer roadmap than most other offshore resource management laws or programs.

Figure 24.2 A “Process Rich” but Clear Path to Offshore Leasing, Exploration, and Development Activities

Pre-Lease	Develop 5-Year Program											
	Solicit Comments	45-day Comment Period	Draft Proposed Program Published	60-day Comment Period	Proposed Program	90-day Comment Period	Proposed Final Program	60-day Waiting Period	5-Year Program Announced			
					Draft EIS Published		Final EIS					
	Planning for Specific Sale											
	Call for Information Published	45-day Comment Period	Define Sale Area	Draft EIS	45-day Comment Period	Final EIS Published	30-day Pre-decision Period	Notice of Sale	30-day Comment Period	Sale	Leases Issued	
						CD to States	90-day Review*					
						Proposed Notice Distributed	60-day Comment Period					
	Post-Lease	Exploration Plan Approval										
		Exploration Plan Submitted	Environmental Assessment	Exploration Plan Approved	90-day CZM Review Approved	APD Approved	Exploration Drilling Starts	First Exploration Well Completed	Delineation Drilling			
			CZM Review Starts							Permits Granted		
Development and Production Plan Approval												
Development and Production Plan		CZM Consistency Review Starts	Draft EIS Published	90-day Comment Period	Final EIS Published	CZM Consistency Obtained	Production Well Application	First Oil/Gas Production				
									Development & Production Plan Approved			

Abbreviations:

APD: Application for Permit to Drill CZM: Coastal Zone Management
 CD: Consistency Determination EIS: Environmental Impact Statement

The process for companies and other stakeholders to comment on proposed sales, and to lease, explore, and develop the outer Continental Shelf, is clearly defined in the Outer Continental Shelf Lands Act. Although the process involves many steps, its comprehensiveness and transparency not only set out clear comment periods for coastal states and other interested stakeholders, but also provide companies greater predictability about the procedures they must follow to receive approval for their exploration and production work.

* Includes 60-day comment period and 15-day automatic extension. Unless state concurs, no decision can be made until 90 days after beginning of state review.

Source: Minerals Management Service, Washington, DC.

After an initial bumpy start in the implementation of major amendments to its basic law, the problems encountered by the offshore oil and gas program today are generally external to its day-to-day administration and regulatory requirements. Although a number of different variables have to be taken into consideration in crafting a regime for other ocean uses, the scope and comprehensiveness of the OCS oil and gas program can be a model for the management of a wide variety of offshore activities.

Trends in Domestic Offshore Oil and Gas Production

Currently, energy development in federal waters accounts for more than 30 percent of domestic oil production and 25 percent of natural gas. Further, of the oil and natural gas still to be discovered in the United States, energy experts estimate that some 60 percent will come from offshore areas.³

More than 95 percent of U.S. offshore oil and gas production takes place in the western and central Gulf of Mexico, where there is an established infrastructure and general public acceptability. There is still some offshore production in Southern California and limited leasing and exploration in federal waters off Alaska. The first oil production from a joint federal-state unit in the Beaufort Sea (Alaska) commenced in 2001.

The importance of offshore oil and natural gas to the nation's total energy portfolio is expected to increase. The U.S. Energy Information Administration projects the United States will need about 35–40 percent more natural gas and about 45 percent more oil by 2025 to meet demand, even as new energy conservation measures are mandated and efforts to develop alternative power sources continue.⁴ Government and industry experts are concerned that rising demand for and limited supplies of natural gas will continue to boost heating and electricity costs, affecting homeowners and a range of major industries. Nearly all U.S. electric-generating plants built since 1998 are fueled by natural gas (Box 24.1).

Rise in Deep-water Oil Production

Although production in the Gulf of Mexico's heavily leased shallow waters has been steadily declining, production in its deeper waters (more than 1,000 feet), which tend to produce more oil than natural gas, increased by over 500 percent between 1995 and 2002.⁵ In part, this growth was attributable to technological breakthroughs, the relative stabilization of crude oil prices, and the enactment of legislation in 1995 granting various levels of royalty relief to lessees willing to make the risky investment in the Gulf's deeper waters. Deep-water oil production now accounts for more than half of the Gulf's total production.⁶ Additionally, the technology for ultra-deep-water development continues to advance with the drilling of a number of exploratory and production wells in water depths greater than 7,000 feet. Recently, a world record exploratory well was drilled in 10,000 feet of water.

A Promising Future for Natural Gas from Shallow Water

MMS estimates there is up to 55 trillion cubic feet (tcf) of natural gas available for production in the deeper stratigraphic horizons on the continental shelf of the Gulf (15,000 feet below the seabed but in shallow-water depths of less than 656 feet). This estimate is 175 percent greater than the previous projection of 20 tcf just a few years ago. This is a hopeful sign of additional sources of natural gas to meet a portion of the nation's future needs. Natural gas production from the deeper horizons on the continental shelf of the Gulf increased from a relatively low 284 billion cubic feet (bcf) in 2000 to 421 bcf in 2002. This 2-year, 50 percent increase follows immediately after a 3-year, 21 percent decrease between 1997 and 2000.⁷ To bolster industry interest in this high-cost deep drilling area, in 2001, MMS instituted a program of deep shelf royalty relief for natural gas production. This economic incentive, combined with more sophisticated cost-effective technology, improved seismic data, better understanding of the potential from the deep shelf, and increased public demand, is likely to provide the impetus for even further accelerated natural gas production from the OCS.

Federal Revenues from Offshore Oil and Gas Leasing and Production

The federal government receives a substantial amount of revenue from energy companies for offshore oil and gas leasing and production. OCS lessees make three categories of pay-

Box 24.1 Offshore Liquefied Natural Gas Ports May Be on the Horizon

The U.S. Department of Energy's Energy Information Administration and private industry trade associations predict that the nation's demand for natural gas will continue to rise.^{i,ii} Notwithstanding estimates of increased natural gas production from the Gulf of Mexico (discussed earlier in this chapter), the United States is no longer self-sufficient in that energy resource. A primary way to meet rising demand is through substantially increased imports of liquefied natural gas (LNG). In 2003, LNG supplied only about 2 percent of U.S. natural gas needs; by 2010, it is expected to provide some 10 percent of such needs.ⁱⁱⁱ

LNG is transported in large, specialized tanker ships that keep the gas cooled to approximately 260°F below zero to reduce the volume for shipping purposes. LNG tankers deliver the gas to special port facilities, where the commodity is re-gasified, either on the ship or at the port facility, and then transported through pipelines to customers.

The United States currently has four LNG import terminals in coastal port areas in Massachusetts, Maryland, Georgia, and Louisiana. Over three dozen new terminals intended to serve the U.S. market (including eight projects proposed for Eastern Canada, the Bahamas, and Baja California, Mexico) are in varying stages of planning.^{iv} For many complex reasons, it is possible that only a few of the projected projects will be built.^v However, of the proposed new LNG projects, a number are likely to be located offshore, on the outer Continental Shelf.

Congress has responded to the need for a broad and cohesive ocean governance structure for offshore LNG ports. The federal Deepwater Port Act (DPA) was amended in 2002 to authorize the siting, construction, and operation of LNG terminals on the OCS, seaward of state boundaries.^{vi} The U.S. Coast Guard and the Maritime Administration are the primary agencies responsible for the licensing process under the DPA. When it was moved to the U.S. Department of Homeland Security, the Coast Guard's authority under the DPA was transferred with it under the terms of an interagency memorandum of understanding (MOU). The MOU also included a number of other agencies that have regulatory authority over some aspect of DPA licensing, or other aspects of LNG transportation and use on the OCS or onshore. These agencies include the U.S. Departments of the Interior, Transportation, and Commerce, the Federal Energy Regulatory Commission, and the U.S. Environmental Protection Agency.

One of the interesting provisions of the DPA, which is applicable to the siting and operation of offshore LNG ports, stipulates that the Secretary of Transportation may not issue a license without the approval of the Governor of each coastal state adjacent to the proposed facility. This gubernatorial approval process is in addition to the federal consistency authority exercised by states with approved coastal zone management programs.

Although the recent amendments to the DPA establish an ocean governance structure for LNG facilities, with designated agency mandates and responsibilities, the siting of new LNG facilities and management of LNG tanker traffic should be fully integrated with the coordinated offshore management regime discussed in Chapter 6.

ⁱ Energy Information Administration. "Annual Energy Outlook 2004 with Projections to 2025" <www.eia.doe.gov/oiaf/aeo/gas.html> Accessed June 3, 2004.

ⁱⁱ National Petroleum Council. "Balancing Natural Gas Policy—Fueling the Demands of a Growing Economy, Executive Summary." <www.npc.org> Accessed May 19, 2004.

ⁱⁱⁱ Energy Information Administration. "Annual Energy Outlook 2004 with Projections to 2025" <www.eia.doe.gov/oiaf/aeo/gas.html> Accessed June 3, 2004.

^{iv} Federal Energy Regulatory Commission, Office of Energy Projects. "Existing and Proposed North American LNG Terminals, June, 2004." <www.ferc.gov/industries/gas/gen-info/horizon-lng.pdf> Accessed June 24, 2004.

^v Energy Information Administration. *Reassessment of Liquefied Natural Gas Supply Potential* in "Annual Energy Outlook 2004 with Projections to 2025." <www.eia.doe.gov/oiaf/aeo/issues_3.html> Accessed June 3, 2004.

^{vi} The Deepwater Port Act, as amended by Section 106 of the Maritime Transportation Security Act of 2002, Pub. L. 107-295, November 25, 2002.

Table 24.1 Federal Revenues from Offshore Mineral Development

Significant funds are paid into the U.S. Treasury each year from outer Continental Shelf (OCS) bonuses, royalties, and rents. This money is used in part to help support federal conservation programs. A small amount generated from nearshore development is shared with OCS producing states.

Year	Oil and Gas Royalties	Bonuses, Rents and Other Revenue	Total by Year
1997	\$3,444,561,989	\$1,814,666,046	\$5,259,228,035
1998	\$2,703,722,873	\$1,618,914,459	\$4,322,637,332
1999	\$2,611,742,229	\$576,646,226	\$3,188,388,455
2000	\$4,094,576,078	\$1,115,086,564	\$5,209,662,642
2001	\$5,448,825,260	\$1,056,762,550	\$6,505,590,810
Total	\$18,303,428,429	\$6,182,075,845	\$24,485,504,274

Source: Minerals Management Service. <www.mrm.mms.gov/Stats/pdfdocs/coll_off.pdf> (Accessed March 2004). Year 2001 data source: MMS Revenue Management Office, Lakewood, CO.

ments: bonus bids when a lease is issued; rental payments before a lease produces; and royalties on any production from the lease. In the half century of the oil and gas program's existence, between 1953 and 2002, it has contributed approximately \$145 billion in federal revenues.⁸ In recent years, the revenues generated from offshore energy activity have averaged \$4–\$5 billion annually (Table 24.1). Although most of the revenues have been deposited directly into the U.S. Treasury, a significant portion has gone to the Land and Water Conservation Fund and the National Historic Preservation Fund.

A Question of Equity: Sharing OCS Receipts with Coastal States

Mineral resources on federal land, whether onshore or offshore, benefit the nation as a whole. The primary law governing onshore mineral development is the Mineral Leasing Act (MLA), and the comparable law for offshore minerals is the OCSLA. These two statutes are analogous in many ways except for one—the sharing of revenues with states. Under the MLA, each of the lower 48 states directly receives 50 percent of all mineral leasing revenues from public lands within its boundaries, and an additional 40 percent through the Reclamation Fund; the state of Alaska receives 90 percent directly. There is a broad array of additional federal land receipts sharing programs, including the National Forest Receipts Program and the Taylor Grazing Act. Eligible uses of the shared receipts vary widely. Some programs require that the funds be used by the recipient jurisdiction for specific purposes such as schools, roads, or land and resource improvements, while others allow the states more discretion.

Furthermore, once leased under the MLA or some other land management statute, onshore federal lands are generally subject to most state and local taxes. Most noteworthy is the ability of states to levy severance taxes on minerals developed on federal lands within their borders. Additionally, if local governments lose property tax revenue because of the existence of federal lands, there are a variety of programs that provide localities with federal payments in lieu of taxes.

In contrast, the OCSLA specifically prohibits state taxes on OCS activities. Moreover, there is no offshore revenue sharing program comparable to the MLA for coastal states. Proponents of such an initiative argue that although the energy development occurs in federal waters, many of the impacts resulting from such activities occur locally, in and near the states' coastal zones. They contend that affected states and communities should receive assistance in coping with the costs of facilitating offshore development, including actions to minimize the risk of environmental damage. The executive branch has traditionally opposed revenue sharing, largely because of the potential loss to the federal treasury.

For decades, Congress has debated proposals on OCS revenue sharing—including the Coastal Energy Impact Program in the mid-1970s—to help states address the effects of offshore production and remedy the apparent inconsistency with onshore mineral development. Disputes over the fair division of revenues from resources discovered in fields that straddle state and federal submerged lands were resolved in 1986. In that year, Congress amended the OCSLA to require that 27 percent of revenues from federal leasing and production activity within three nautical miles seaward of the federal–state offshore boundary be given to the affected state. Through the release of money that was being held in escrow, the awarding of past payments owed to the states, and subsequent entitlement to 27 percent of current and future revenues from the three-mile area, the seven OCS “producing” states have received slightly more than \$3 billion since 1986. Currently, these states receive approximately \$50–60 million annually through this mechanism. In fiscal year 2001, Congress authorized and appropriated \$142 million for a Coastal Impact Assistance Program to be allocated among the producing states by the National Oceanic and Atmospheric Administration (NOAA). However, this was a one-year authorization, and no further funding has been provided.

The Federal-State Partnership for Oceans and Coasts

In various parts of this report, recommendations are made not only to strengthen the coordination of ocean policy at the federal level, but also to increase the involvement of nonfederal governmental and nongovernmental stakeholders. The time has come to significantly enhance the ocean and coastal partnership between the federal government and state, territorial, tribal, and local governments. This partnership recognizes that much of the responsibility for managing the nation’s ocean and coastal resources rests with nonfederal authorities. These concepts are at the heart of the CZMA and permeate many other natural resource management programs.

As the federal-state ocean and coastal partnership began to evolve, the nation determined that activities associated with development of nonrenewable resources should not be pursued at the expense of the long-term health of renewable resources. That is why the OCSLA, the CZMA, and other applicable federal statutes call for balanced management of offshore oil and gas, protection of the ocean and coastal environment, and involvement by state and local governments. Eventually, new oil and gas will no longer be found or developed in the nation’s submerged lands but, if the proper policies are pursued, the renewable resources of our estuaries, coasts, oceans, and the Great Lakes—and the economic activities that depend upon them—will remain healthy and strong.

To make certain that the federal-state partnership remains strong and that critical marine ecosystems are protected, more of the resource rents generated from OCS energy leasing and production should be invested in the sustainability of ocean and coastal resources.

Recommendation 24–1

Congress should use a portion of the revenues the federal government receives from the leasing and extraction of outer Continental Shelf (OCS) oil and gas to provide grants to all coastal states that can be invested in the conservation and sustainable development of renewable ocean and coastal resources. States off whose coasts OCS oil and gas is produced should receive a larger share of such revenue to compensate them for the costs of addressing the environmental and socioeconomic impacts of energy activity in adjacent federal waters. None of the programs that currently receive revenues from OCS oil and gas activities should be adversely affected by this new allocation.

Chapter 30, *Funding Needs and Possible Sources*, includes a more extensive discussion about offshore revenue sharing and its connection to improved ocean and coastal management.

State Involvement in OCS Oil and Gas Decision Making

The partnership between the federal and state governments with respect to activities in federal waters should involve more than the sharing of some revenues. The central role of states in the new ocean policy framework is addressed in practically every chapter of this report. For example, Chapter 6 specifically calls for a more robust federal-regional-state dialogue in the building of coordinated offshore management regime. Chapter 9 addresses the link between coastal and offshore management, including the role of the federal consistency provision of the CZMA, despite some disagreements between levels of government, in enhancing cooperative federalism.

With respect to offshore oil and gas, the 1978 amendments to the OCSLA were intended, among many purposes, to bring state and local governments into much clearer and statutorily specified consultative roles at various points in DOI's decision-making process. Further, the amendments made clear that the federal consistency provision of the CZMA applied to exploration, development, and production plans submitted to the Secretary of the Interior under the OCSLA. (Box 24.2 provides additional information on the federal consistency provision.)

Environmental Issues Related to Offshore Oil and Gas Production

As with most industrial development activities, along with the economic- and energy-related benefits of OCS oil and gas production, are actual and perceived risks to the environment, coastal communities, and competing users. Since the 1969 Santa Barbara blowout, the U.S. oil industry's environmental and safety record has improved significantly, as has the regulatory regime of DOI. Today, safety stipulations are more stringent, technologies are vastly improved, inspections are regular and frequent, and oil spill response capabilities are in place. Nevertheless, there remain numerous environmental issues associated with the development and production of oil and gas from the OCS.

Foremost among these are:

- Physical damage to coastal wetlands and other fragile areas by OCS-related onshore infrastructure and pipelines.
- Physical disruption of and damage to bottom-dwelling marine communities.
- Discharge of contaminants and toxic pollutants present in drilling muds and cuttings and in produced waters.
- Emissions of pollutants from fixed facilities, vessels, and helicopters.
- Seismic exploration and production noise impacts on marine mammals, fish, and other wildlife.
- Immediate and long-term ecological effects of large oil spills.
- Chronic, low-level impacts on natural and human environments.
- Cumulative impacts on the marine, coastal, and human environments.

The most obvious of these risks, and the one most commonly cited, is the potential for oil spills including drill rig blowouts, pipeline spills, and chronic releases from production platforms. The impacts of large oil spills can last from years to decades, particularly in critical habitats, such as wetlands and coral reefs.

According to MMS, 97 percent of OCS spills are one barrel or less in volume and U.S. OCS offshore facilities and pipelines accounted for only 2 percent of the volume of oil released into U.S. waters for the period 1985–2001 (Figure 24.3).⁹ The total volume and number of such spills over that period declined significantly due to industry safety practices and improved spill prevention technology. By comparison, the National Research Council (NRC) estimated that 690,000 barrels of oil enter North American ocean waters each year from land-based human activities, and another 1,118,000 barrels result from natural seeps emanating from the seafloor.¹⁰

John Wesley Powell, the Civil War veteran and explorer who led the first expedition down the Colorado river, had the fundamental insight that natural resources do not respect political boundaries. [His] insight fully applies to the resources of the Outer Continental Shelf—whether they be commercial fisheries, oil and gas, or endangered species. Everything that happens on the federal OCS affects state waters and the land and people of the adjoining states.

—Robert Wiygul, Environmental Attorney, Waltzer & Associates, testimony to the Commission, March 2002

Box 24.2 The Federal Consistency Provision and Offshore Oil and Gas Development

The application of the federal consistency provision of the Coastal Zone Management Act (CZMA) to offshore energy development has been one of the most contentious issues among the federal government, coastal state governments, and outer Continental Shelf (OCS) lessees. In the mid-1970s, Congress amended the original version of the federal consistency provision to add a section that explicitly covered certain OCS activities. Of the thousands of exploration and development plans submitted by oil and gas companies over the years and approved by the U.S. Department of the Interior (DOI), states have concurred with the consistency of such plans with their state coastal management program in virtually all of the cases. But there have been some instances in which states have objected and these are generally cases of high visibility. There have been fourteen OCS oil and gas appeal decisions issued by the Secretary of Commerce, half of which overrode the state's objection and half of which did not.

In a case that reached the highest court in the land in 1984, the U.S. Supreme Court held that OCS lease sales were not subject to the consistency provision of the CZMA. In 1990, Congress enacted a law, which reversed the effect of the decision, clarified that such sales are subject to a state consistency review, and made a number of other changes to the interpretation of the federal consistency provision that resulted in a lengthy rule-making process by the National Oceanic and Atmospheric Administration (NOAA). The final rule was published in 2000.

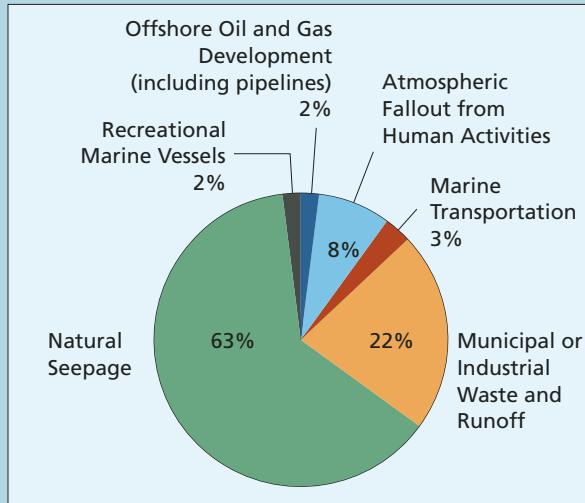
In 2001, the Vice President submitted the National Energy Policy report of the National Energy Policy Development Group to the President.ⁱ The report contained a section on the Outer Continental Shelf Lands Act (OCSLA), as administered by DOI's Minerals Management Service, and the CZMA, as carried out by NOAA. It noted that the effectiveness of these programs is "sometimes lost through a lack of clearly defined requirements and information needs from federal and state entities, as well as uncertain deadlines during the process." The report recommended that the Secretaries of Commerce and the Interior reexamine the legal and policy regimes to see if changes were needed regarding energy activities in the coastal zone and the OCS.

In 2003, after a series of negotiations between the two departments, the Department of Commerce published a proposed rule addressing the information needs of states, coordination of timing requirements between the OCSLA and the CZMA, definitive time limits on the Secretary of Commerce's appeals process, and additional procedural matters. (For a more detailed discussion of the OCS-specific federal consistency provisions of the CZMA and the issues related to their implementation, including a history of related litigation, see Appendix 6.)

ⁱ National Energy Policy Development Group. *National Energy Policy: Reliable, Affordable, and Environmentally Sound Energy for America's Future*. Washington, DC: Executive Office of the President, May 2001.

Since 1981, the volume of oil spilled from OCS pipelines is four to five times greater than that from OCS platforms (Figure 24.4).¹¹ Third party impacts due to events such as anchor dragging and ship groundings, and damages resulting from natural disasters such as hurricanes and underwater landslides, are leading causes of pipeline spills. As noted by the NRC, spills due to structural failures in aging pipelines are also a growing concern.¹² Long-term exposure to weather and marine conditions makes pipelines older than twenty-five years considerably more susceptible to stress fractures and material fatigue that can lead to spills and leaks. In addition, older pipelines do not incorporate the advanced oil spill detection and prevention technologies that have been developed in recent years.

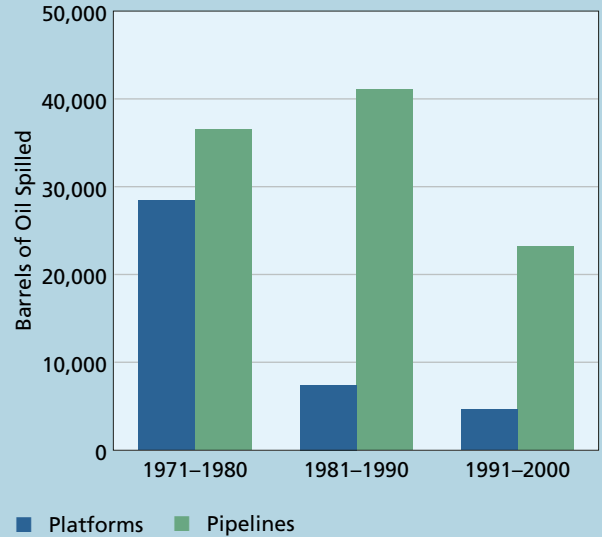
Figure 24.3 Oil Inputs to the North American Marine Environment



Offshore oil and gas development contributes only 2 percent of the 1.8 million barrels of oil released into North American waters each year. Natural seepage from the seafloor is by far the largest input, while runoff and waste from human land-based activities contribute roughly a quarter of the oil present in the marine environment. On a worldwide basis, the oil released from offshore oil and gas development still only accounts for 4 percent of the total 8.9 million barrels. (One barrel is equal to 42 gallons.)

Source: Minerals Management Service. "OCS Oil Spill Facts, 2002." <www.mms.gov/stats/PDFs/2002_OilSpillFacts.pdf> (Accessed March 2004).

Figure 24.4 Pipelines Are a Leading Source of Oil Leaks from OCS Infrastructure



In the last thirty years, the amount of oil spilled from OCS platforms and pipelines has continued to decrease. The large disparity between the number of barrels spilled from platforms versus pipelines is indicative of improvements in platform technology and operations and the greater susceptibility of pipelines to third party damages, natural hazards, and structural failure brought on by corrosion and materials fatigue.

Source: Minerals Management Service. "OCS Oil Spill Facts, 2002." <www.mms.gov/stats/PDFs/2002_OilSpillFacts.pdf> (Accessed March 2004).

The MMS Environmental Studies Program (ESP) is a major source of information about the impacts of OCS oil and gas activities on the human, marine, and coastal environments. Since 1986, annual funding for the program has decreased, in real dollars, from a high of \$56 million to approximately \$18 million in 2003. Even accounting for the contraction in the areas available for leasing, the erosion in ESP funding has occurred at a time when more and better information, not less, is needed. There continues to be a need to better understand the cumulative and long-term impacts of OCS oil and gas development, especially in the area of low levels of persistent organic and inorganic chemicals, and their cumulative or synergistic effects.

Also, as noted, OCS oil and gas exploratory activities in the Gulf of Mexico are now occurring in water depths approaching 10,000 feet with projections that the industry will achieve 15,000 feet drilling capabilities within the next decade. The technological ability to conduct oil and gas activities in ever deeper waters on the OCS places a significant and important responsibility on MMS to collect the essential environmental deep-water data necessary for it and other agencies to make informed management and policy decisions on exploration and production activities at those depths. Thus, as the knowledge base increases and the industry expands its activities further offshore and into deeper waters, new environmental issues are emerging that cannot all be adequately addressed under the current ESP budget.

Recommendation 24–2

The U.S. Department of the Interior should expand the Minerals Management Service's Environmental Studies Program.

Priorities for the enhanced Environmental Studies Program should include:

- conducting long-term environmental research and monitoring at appropriate outer Continental Shelf (OCS) sites to better understand cumulative, low-level, and chronic impacts of OCS oil and gas activities on the natural and human environments.
- working with state environmental agencies and industry to evaluate the risks to the marine environment posed by aging offshore and onshore pipelines, particularly in the Gulf of Mexico.

Opportunities for Sharing Ocean Observation Information and Resources

Floating drilling rigs and production platforms are able to maintain position over the tops of wells thousands of feet below the surface without the need for mooring or permanent structures. Dynamic positioning systems compensate for wind, waves, and currents to keep the vessel stationary relative to the seabed, and new hull designs maintain stability. Three- and four-dimensional subsurface images allow operators to obtain a better idea of how a reservoir behaves and increase the likelihood of drilling success. And, the use of horizontal and directional drilling creates more flexibility in deciding where to site offshore platforms.

The movement of oil and natural gas exploration, development, and production activities further offshore into deeper waters and harsher marine environments, such as the Arctic, affords an excellent opportunity for incorporating the industry's offshore infrastructure into the national Integrated Ocean Observing System (IOOS). In addition to its offshore infrastructure, the industry has the technological capacity to collect, assimilate, and analyze environmental data of use in both IOOS forecasts and more general ocean and environmental models and data products (which are discussed in more detail in Chapter 28). The U.S. offshore industry has a history of partnering with ocean scientists, allowing them to use production platforms for mounting environmental sensors, and in some cases, collecting and providing them with environmental data and information. The industry would also benefit from participation in the IOOS as a user of the system's data and information products and by being involved in its design, implementation, and future enhancement.

Recommendation 24–3

Ocean.US, working with the National Oceanic and Atmospheric Administration (NOAA) and Minerals Management Service (MMS), should include the offshore oil and gas industry as an integral partner in the design, implementation, and operation of the Integrated Ocean Observing System (IOOS), especially in areas where offshore oil and gas activities occur.

Specifically, Ocean.US, NOAA, and MMS should work with the oil and gas industry to:

- employ industry resources, such as pipelines, platforms, and vessels as part of the IOOS.
- incorporate nonproprietary data into IOOS informational products and larger environmental databases, while protecting the security of proprietary data and meeting other safety, environmental, and economic concerns.

Assessing the Potential of Offshore Methane Hydrates

Conventional oil and gas are not the only fossil-based fuel sources located beneath ocean floors. Methane hydrates are solid, ice-like structures composed of water and natural gas. They occur naturally in areas of the world where methane and water can combine at appropriate conditions of temperature and pressure, such as in thick sediment of deep-ocean basins, at water depths greater than 1,650 feet.

The estimated amount of natural gas in the gas hydrate accumulations of the world greatly exceeds the volume of all known conventional gas resources.¹³ A 1995 U.S. Geological Survey (USGS) estimate of both marine and Arctic hydrate resources revealed the immense energy potential of hydrates in the United States.¹⁴ These deposits have been identified in Alaska, the east and west coasts of the United States, and in the Gulf of Mexico. USGS estimated that the methane hydrates in U.S. waters hold a mean value of 320,000 trillion cubic feet of natural gas, although subsequent refinements of the data have suggested that the estimate is a slightly more conservative 200,000 trillion cubic feet.¹⁵ Even this lower estimate is enough to supply all of the nation's energy needs for more than 2,000 years at current rates of use.¹⁶

However, there is still no known practical and safe way to develop the gas and it is clear that much more information is needed to determine whether significant technical obstacles can be overcome to enable methane hydrates to become a commercially viable and environmentally acceptable source of energy.

In the United States, federal research concerning methane hydrates has been underway since 1982, was intensified in 1997–98, and received further emphasis with the passage of the Methane Hydrate Research and Development Act in 2000. That Act established an interagency coordination mechanism that includes the U.S. Departments of Energy, Commerce, Defense, and the Interior, and the National Science Foundation, and directed the National Research Council to conduct a study on the status of research and development work on methane hydrates. This study is scheduled for release in September 2004.

Recommendation 24–4

The National Ocean Council (NOC), working with the U.S. Department of Energy and other appropriate entities, should review the status of gas hydrates research and development to determine whether methane hydrates can contribute significantly to meeting the nation's long-term energy needs. If such contribution looks promising, the NOC should recommend an appropriate level of investment in methane hydrates research and development, and determine whether a comprehensive management regime for industry access to hydrate resource deposits is needed.

Developing Offshore Renewable Energy Resources

Environmental, economic, and security concerns have heightened interest among many policy makers and the public in renewable sources of energy. Although offshore areas currently contribute little to the nation's supply of renewable energy, the potential is significant and could include wind turbines, mechanical devices driven by waves, tides, or currents, and ocean thermal energy conversion, which uses the temperature difference between warm surface and cold, deep-ocean waters to generate electricity.

Offshore Wind Energy Development

While the offshore wind power industry is still in its infancy in the United States, it is being stimulated by improved technology and federal tax credits that have made it more attractive commercially. Additionally, developers are looking increasingly to the lead of European countries such as Denmark, the United Kingdom, and Germany, where growing numbers of offshore projects are being licensed.

In fact, the United States already has a wind energy management program applicable on some federal lands onshore. This comprehensive program is carried out by DOI's Bureau of Land Management under broad authority provided by the Federal Land Policy and Management Act.

Conversely, there is no comprehensive and coordinated federal regime in place to regulate offshore wind energy development or to convey property rights to use the public space of the OCS for this purpose. In the absence of a specific regime, the U.S. Army Corps of Engineers (USACE) is the lead federal agency responsible for reviewing and granting a permit for this activity. Its authority, however, is based on Section 10 of the Rivers and Harbors Act, which, although it has a public interest requirement, primarily regulates obstructions to navigation, including approval of any device attached to the seafloor.

In reviewing a proposed project under Section 10, the USACE is required by the National Environmental Policy Act to consult other federal agencies. Depending on the circumstances, these agencies and authorities may include:

- The U.S. Coast Guard, which regulates navigation under several federal statutes.
- The Federal Aviation Administration, which regulates objects that may affect navigable airspace pursuant to the Federal Aviation Act.
- The U.S. Environmental Protection Agency, which may conduct a review for potential environmental impacts of a project pursuant to the Clean Water Act and Clean Air Act.
- The National Marine Fisheries Service (NMFS), which may review projects for potential impacts to fishery resources pursuant to the Magnuson-Stevens Fishery Conservation and Management Act. In addition, NMFS' review includes assessing potential impacts to endangered or threatened species under the Endangered Species Act or the Marine Mammal Protection Act.
- The U.S. Fish and Wildlife Service, which may review projects for potential impacts to endangered species or marine mammals under its jurisdiction pursuant to the Endangered Species Act or the Marine Mammal Protection Act.
- In addition, depending on its location, a wind energy project, or at least its Section 10 permit, may be subject to review by one or more state coastal management programs in accordance with the CZMA federal consistency provisions.

The Section 10 review process stands in stark contrast both to the well established DOI regulatory program for onshore wind energy and, in the marine setting, to the robust regulatory program for offshore oil and gas that has developed under the OCSLA. Using the Section 10 process as the primary regulatory vehicle for offshore wind energy development is inadequate for a number of reasons. First and foremost, it cannot grant leases or exclusive rights to use and occupy space on the OCS. It is not based on a comprehensive and coordinated planning process for determining when, where, and how this activity should take place. It also lacks the ability to assess a reasonable resource rent for the public space occupied or a fee or royalty for the energy generated. In other words, it lacks the management comprehensiveness that is needed to take into account a broad range of issues, including other ocean uses in the proposed area and the consideration of a coherent policy and process to guide offshore energy development.

Wave Energy Conversion—Current and Tidal

Various technologies have been proposed to use wave or tidal energy, usually to produce electricity. The wave energy technologies for offshore use include floating or pitching devices placed on the surface of the water that convert the horizontal or vertical movement of the wave into mechanical energy that is used to drive a turbine. Currently, the offshore wave, tidal, and current energy industry is in its infancy. Only a small proportion of the technologies have been tested and evaluated.¹⁷ Nonetheless, some projects are moving forward in the United States, including one to install electricity-producing wave-energy buoys more than 3 nautical miles offshore Washington State, in the Olympic Coast National Marine Sanctuary. Internationally, there is considerable interest in wave, tidal, and current energy, but the projects are almost all in the research and development stage.

Box 24.3 A Mighty Wind Blows in Cape Cod

Although offshore wind energy facilities are well-established in other areas of the world, the first proposal for such a facility in the United States is testing the ability of the federal system to manage emerging offshore industries. The proposal calls for use of approximately 23 square miles in the Nantucket Sound, some 5.5 nautical miles off the coast of Cape Cod, Massachusetts. It would consist of 130 wind turbines, each of which would be sunk into the ocean floor and reach up to 420 feet above the ocean surface. The project would generate an annual average of approximately 160 megawatts of electrical power.ⁱ

This project has divided local citizens, elected officials, environmentalists, business interests, and other stakeholders. Supporters cite the project's potential to reduce pollution, greenhouse gases, and reliance on foreign oil, while opponents warn of bird deaths, harm to tourism, interference with commercial and sports fishing, and obstructed views.

Despite the controversy, the project is proceeding through the review process contained in Section 10 of the Rivers and Harbors Act. In the meantime, proposals for offshore wind development projects up and down the East Coast are proliferating.



British Wind Energy Association

ⁱ U.S. Army Corps of Engineers. "Commercial Scale Wind Energy Generation Project for the NE Grid." <www.nae.usace.army.mil/projects/ma/ccwf/farmfact.pdf> Posted March 3, 2004; accessed March 11, 2004.

The Federal Energy Regulatory Commission (FERC) asserts jurisdiction, under the Federal Power Act (FPA), over private, municipal, and state (not federal) hydropower projects seaward to 12 nautical miles. FERC has formally asserted jurisdiction over the Washington State project, and is likely to assert jurisdiction over all forms of wave, tidal, or current energy projects whose output is electricity, from the shoreline out to 12 nautical miles offshore, on the basis that they are "hydropower" projects under the FPA.

Although in issuing a license for a wave, current, or tidal project, FERC is directed by the FPA to equally consider environmental and energy concerns, it is not an agency with a broad ocean management mission. As with wind energy, several other federal laws may apply to ocean wave projects. For example, NEPA, the federal consistency provision of the CZMA, the National Historic Preservation Act, and the Fish and Wildlife Coordination Act may apply, as may the consultation provisions of the Endangered Species Act and the Marine Mammal Protection Act. But there is no comprehensive law that makes clear which of these individual laws may be applicable, nor is there any indication that overall coordination is a goal, thus leaving implementation to mixed federal authorities.

Ocean Thermal Energy Conversion

The surface waters of the world's tropical oceans store immense quantities of solar energy. Ocean thermal energy conversion (OTEC) technology could provide an economically efficient way to tap this resource to produce electric power and other products. The U.S. government spent over \$200 million dollars in OTEC research and development from the

1970s to the early 1990s that produced useful technical information but did not result in a commercially viable technology.¹⁸

Early optimism about the potential of OTEC led to the enactment of the Ocean Thermal Energy Conversion Act in 1980, and the creation of a coordinated framework and licensing regime for managing that activity if and when economic considerations permitted. NOAA issued regulations to implement the Act, but because of investor risk for this capital-intensive technology and relatively low fossil fuel prices, no license applications were ever received and NOAA subsequently rescinded the regulations in 1996. Thus, the United States currently has no administrative regulatory structure to license commercial OTEC operations.

Comprehensive Management for Offshore Renewable Energy

Offshore renewable technologies will continue to be studied as a means of reducing U.S. reliance on potentially unstable supplies of foreign oil, diversifying the nation's energy mix, and providing more environmentally benign sources of energy. Similar to offshore aquaculture described in Chapter 22, the offshore renewable processes described in this section present obvious examples of the shortcomings in federal authority when it comes to regulating specific new and emerging offshore activities. As long as federal agencies are forced to bootstrap their authorities to address these activities, the nation runs the risk of unresolved conflicts, unnecessary delays, and uncertain procedures. What is urgently needed is for the National Ocean Council to develop a comprehensive offshore management regime (as recommended in Chapter 6) that considers all offshore uses within a larger planning context. A coherent and predictable federal management process for offshore renewable resources that weighs the benefits to the nation's energy future against the potential adverse effects on other ocean users, marine life, and the ocean's natural processes, should be fully integrated into the broader management regime.

Recommendation 24–5

Congress, with input from the National Ocean Council, should enact legislation providing for the comprehensive management of offshore renewable energy development as part of a coordinated offshore management regime.

Specifically, this legislation should:

- be based on the premise that the oceans are a public resource.
- streamline the process for licensing, leasing, and permitting renewable energy facilities in U.S. waters.
- subsume existing statutes, such as the Ocean Thermal Energy Conversion Act.
- ensure that the public receives a fair return from the use of the resource and that development rights are allocated through an open, transparent process that considers state, local, and public concerns.

Managing Other Marine Minerals

The ocean floor within the U.S. EEZ contains vast quantities of valuable minerals other than oil and gas, but the economics of recovering them, especially in areas far offshore, are not welcoming. These resources include more than 2 trillion cubic meters of sand and gravel reserves on the Atlantic shelf of the OCS alone, enormous phosphate deposits off the East Coast from North Carolina to northern Florida, titanium-rich heavy mineral sands from New Jersey to Florida, manganese nodules from South Carolina to Georgia, high-grade calcium carbonate sands off Florida, gold and platinum deposits off Alaska, polymetallic sulfides off Oregon, barite resources off southern California, and quantities of cobalt and platinum off Hawaii. It is likely that substantial amounts of other valuable minerals will be identified in the future as exploration proceeds. Access to these minerals for

commercial recovery, including offshore sand and gravel for use as construction aggregate, is through the competitive leasing process of the OCSLA.

In 1994, Congress authorized coastal communities to use sand and gravel from the OCS for public works projects without going through the statute's bidding process. Since then, MMS has used this authority to allow federal, state, and local agencies to mine OCS sand to protect shorelines, nourish beaches, and restore wetlands. Between 1995 and 2004, MMS provided over 20 million cubic yards of OCS sand for 14 coastal projects.¹⁹ Louisiana alone is expected to seek millions of cubic yards of OCS sand for various barrier island restoration projects and levee systems.²⁰

The depletion of OCS sand in state waters after decades of excavation, and growing environmental opposition to the activity in areas close to shore, are exacerbated by the acceleration of erosion, ever-expanding coastal populations, and on the increasing vulnerability of fragile beaches, exposed beachfront property, and coastal-dependent industries to coastal storms. With the need for sand increasing and its availability in state waters decreasing, the OCS provides the obvious remedy. It is not, however, a remedy without associated problems.

MMS has numerous environmental studies underway or planned to evaluate the effects of OCS dredging on the marine and coastal environment and to identify ways to eliminate or mitigate harmful impacts. There remains, nevertheless, significant uncertainty about the long-term, cumulative impacts of sand and gravel mining on ocean systems and marine life. Changes in bathymetry can affect waves and currents in a manner that could increase shoreline erosion. Alterations to the ocean bottom can affect repopulation of the benthic community, cause increased turbidity, damage submerged resources such as historic shipwrecks, and kill marine organisms, including fish. For economic reasons, the demand for sand and gravel leases will most likely concentrate on OCS areas that are relatively close to shore. Some environmentalists and fishing representatives have opposed mining in state waters and may well oppose similar projects in adjacent federal waters.

A vital component of a national strategy to manage mineral resources located on the OCS is the need for an overall assessment of: the nation's OCS mineral endowment (sand and gravel, as well as other strategic minerals vital to the long-term security of the nation); the need for those resources (highest and best uses); the long-term environmental impacts associated with use of those resources; and the multiple-use implications of other uses of the OCS (including wind farms, cables, and pipelines). While resource managers have identified large volumes of sand off the nation's shores, the ultimate volumes that may be recovered remain unknown. Sand and gravel resources from the OCS are key to protecting the nation's shores and wetlands and to supplementing ever-diminishing onshore supplies of aggregate to support construction activities.

Recommendation 24–6

The Minerals Management Service should systematically identify the nation's offshore non-energy mineral resources and conduct the necessary cost-benefit, long-term security, and environmental studies to create a national program that ensures the best uses of those resources.

References

- ¹ Minerals Management Service. "Total OCS Gas Production." <www.mms.gov/stats/PDFs/OCSNaturalGasProduction_March2004.pdf> Accessed March 11, 2004.
- ² Minerals Management Service. "Federal Offshore Crude and Condensate Production: 1992–2003." <www.mms.gov/stats/PDFs/FederalOffshoreCrudeCondensateProduction92-03_March2004.pdf> Accessed March 11, 2004.
- ³ Minerals Management Service. "Offshore Minerals Management." <www.mms.gov/offshore/> Accessed March 9, 2004.
- ⁴ Energy Information Administration. *Annual Energy Outlook 2004*. DOE/EIA-X053. Washington, DC: U.S. Department of Energy, January 2004.

- ⁵ Richardson, G.E., et al. *Deepwater Gulf of Mexico 2004: America's Expanding Frontier*. OCS Report MMS 2004-021. New Orleans, LA: U.S. Department of the Interior, Minerals Management Service, May 2004.
- ⁶ Ibid.
- ⁷ Minerals Management Service. "Deep Shelf Gas May Be More Abundant in Gulf Than Earlier Forecast Probabilistic Estimate Increases by 175%." <www.gomr.mms.gov/homepg/whatsnew/newsreal/031119.html> Posted November 19, 2003; accessed March 12, 2004.
- ⁸ Minerals Management Service, "Total Federal Offshore Minerals Revenue Collections, Calendar Years 1953-2000." <www.mrm.mms.gov/stats/pdfdocs/coll_off.pdf> Accessed March 9, 2004. Year 2001 and 2002 data source: MMS Revenue Management Office, Lakewood, CO.
- ⁹ Minerals Management Service. "OCS Oil Spill Facts." Washington, DC: U.S. Department of the Interior, September 2002.
- ¹⁰ National Research Council. *Oil in the Sea III: Inputs, Fates and Effects*. Washington, DC: National Academy Press, 2003.
- ¹¹ Minerals Management Service. *OCS Oil Spill Facts*. Washington, DC: U.S. Department of the Interior, September 2002.
- ¹² National Research Council. *Oil in the Sea III: Inputs, Fates and Effects*. Washington, DC: National Academy Press, 2003.
- ¹³ U.S. Department of the Interior, U.S. Geological Survey. "Gas Hydrates—Will They be Considered in the Future Global Energy Mix?" <www.usgs.gov/public/press/public_affairs/press_releases/pr1824m.html> Posted December 10, 2003; accessed March 12, 2004.
- ¹⁴ National Oil and Gas Resource Assessment Team. *1995 National Assessment of United States Oil and Gas Resources*. U.S. Geological Survey Circular 1118. Washington, DC: U.S. Government Printing Office, 1995.
- ¹⁵ Congressional Research Service. "Methane Hydrates: Energy Prospect or Natural Hazard?" <www.cnire.org/nle/crsreports/energy/eng-46.pdf> Updated February 14, 2004; accessed March 12, 2004.
- ¹⁶ Monastersky, R. "The Ice That Burns: Can Methane Hydrates Fuel the 21st Century?" *Science News* 154, no. 20 (November 14, 1998): 312.
- ¹⁷ California Energy Commission. "Ocean Energy." <www.energy.ca.gov/development/oceanenergy/> Accessed December 16, 2003.
- ¹⁸ Jones, A.T., and W. Rowley. "Global Perspective: Economic Forecast for Renewable Ocean Energy Technologies." *Marine Technology Society Journal* 36, no. 4 (Winter 2002-2003).
- ¹⁹ Minerals Management Service. "Offshore Sand and Gravel Facts." <www.mms.gov/sandandgravel/pdf/sandandgravelfactsheet.pdf> Accessed March 12, 2004.
- ²⁰ Minerals Management Service. "Sand and Gravel Program—Offshore Minerals Management: Louisiana." <www.mms.gov/sandandgravel/louisiana.htm> Updated January 29, 2004; accessed March 12, 2004.

