7 ANALYSIS OF THE PROPOSED ACTION AND ITS ALTERNATIVES

The proposed action is the establishment of the Minerals Management Service (MMS) Alternative Energy and Alternate Use (AEAU) Program on the Federal Outer Continental Shelf (OCS) through rulemaking. Under the AEAU Program, the MMS would accept for consideration proposals for alternative energy development on the OCS as well as activities that involve the alternate use of existing structures on the OCS after promulgation of the final rule. Then, according to the provisions of the new regulations, the MMS would issue leases, easements, or rights-of-way (ROWs) authorizing such activities. Any authorizations under this program would be subject to individual environmental analyses under the National Environmental Policy Act (NEPA). In Section 7.1, the overall potential impacts (both positive and negative) of implementing the proposed action are addressed. Considered are the impacts from the areas included in Chapter 5 for the alternative energy program (i.e., ocean surface and sediments; air quality; ocean currents and movements; water quality; acoustic environment; hazardous materials and waste management; electromagnetic fields; marine and coastal biota and habitats; areas of special concern; military use areas; transportation; socioeconomic resources; cultural resources; land use and existing infrastructure; visual resources; tourism and recreation; fisheries; and nonroutine conditions) and the impacts from areas addressed in Chapter 6 for the alternate use program.

The impacts of the case-by-case, no action, and preferred alternatives are also considered for comparison (Sections 7.2, 7.3, and 7.4, respectively). Because the development of offshore alternative energy sources could result in indirect impacts through decreased use of other energy sources, impacts from other sources (including coal, natural gas, nuclear power, and other land-based sources) are discussed in Section 7.5. Cumulative impacts are discussed in Section 7.6, and other NEPA considerations are discussed in Section 7.7.

7.1 IMPACTS OF THE PROPOSED ACTION

Under the proposed action, impacts from both offshore alternative energy facilities and the alternate use of existing oil and gas platforms are considered.

7.1.1 Offshore Alternative Energy

The proposed action analyzed in this programmatic Environmental Impact Statement (EIS) (as described in Section 1.1) is authorized by subsection 8(p) of the OCS Lands Act (OCSLA). The purpose of this action is to establish a program implementing the MMS's new authority. This new program establishes a process to authorize leases, easements, and ROWs for activities that involve new technologies that are in the early stages of development. Consequently, the scope and time frame of this EIS are limited to current understanding of the technologies and possible activities that may be initiated in the foreseeable future—5 to 7 years (2007–2014).

The establishment of a national program for authorizing alternative energy project activities on the Federal OCS would provide increased assurance that potential adverse effects on humans and biota from such projects would be thoroughly considered, and that appropriate and standard mitigation measures would be required for each project. The need for policies to guide the sustainable use and conservation of ocean resources on the OCS during wind power development has been recognized by government agencies and technology developers, resulting in a recent collaborative effort to develop strategies for that development (MTC et al. 2005).

The potential generalized impacts from technology testing, site characterization, construction, operation, and decommissioning, as described in detail in Chapter 5, are summarized in Table 7.1.1-1 for wind, wave, and ocean current energy conversion technologies. Identified impact levels include the use of mitigation measures (see definition of impact levels in Section 5.1) and use a four-level classification scheme (negligible, minor, moderate, or major) to characterize the impacts predicted if the activities occur as assumed. Negligible impacts are those that are not measurable, while minor impacts could be avoided with proper mitigation or the affected resource would recover completely if the impacting agent were eliminated. Moderate and major impacts are unavoidable, where some impacts may be irreversible or proper mitigation would allow complete recovery of a resource for moderate impacts, and major impacts would threaten a resource's viability and result in incomplete recovery even with proper mitigation.

The evaluation of impacts summarized below is necessarily general, because this programmatic EIS does not evaluate specific OCS alternative energy projects within the Atlantic OCS area and the Gulf of Mexico and Pacific regions. Subsequent site-specific environmental impact analyses will analyze impacts more closely and identify any further specific mitigation measures for reducing impact levels.

Potential impacts from alternative energy technologies for all resource areas are summarized as follows:

- **Ocean surface and sediments:** Potential hazards from scouring around structures by ocean currents would be negligible to minor. Impacts to coastal sedimentary processes from wave facilities would be negligible to minor, assuming that facilities are located more than 2 km (1.2 mi) from shore and/or are parallel to the direction of wave travel.

- **Air quality:** Minor to moderate impacts from possible short-term exceedance of dust standards during onshore construction, possible contributions to ozone exceedance episodes in nonattainment areas, and/or exceedance of sulfur dioxide (SO_2) increments in Class I areas during offshore construction or maintenance.

- **Ocean currents and movement:** Possible impacts to regional climate and ecology for current energy projects extracting more than 4% of a current's energy. This level of development is not expected over the next 5 to 7 years. Impacts would depend on the design of the technology, and the magnitude of impacts is uncertain.

TABLE 7.1.1-1 Summary of Potential Impacts from Testing, Site Characterization, Construction, Operation, and Decommissioning for Wind, Wave, and Ocean Current Technologies

Technical Area	Wind	Wave	Ocean Current
Ocean surface and sediments	Impacts from scouring around structures would be negligible to minor with respect to unique geologic features, acceleration of erosion, and alteration of topography. Mitigation measures include: To avoid sediment transport problems in areas where loss of beach sand is a concern, site farther offshore. Hazards posed by seafloor instability, with possible damage to foundations or cables, could be mitigated through siting away from known areas of geologic instability and/or allowing slack in cable systems. Scouring could be mitigated through use of scour protection devices.	Same as for wind energy. Also can mitigate sediment transport problems through appropriate siting and/or configuring of wave energy conversion (WEC) locations within a facility.	Same as for wind energy.
Air quality	Minor impacts during testing, site characterization, operation, and decommissioning. Minor to moderate site-specific impacts from onshore and offshore construction activities due to emissions of criteria pollutants from internal combustion engines in vehicles, vessels, and equipment, and short-term fugitive dust emissions from earthmoving and vehicle traffic. Mitigation measures include: meeting permitting requirements, standard dust control practices, and vessel, vehicle, and equipment emission and fuel-type controls.	Same as for wind energy.	Same as for wind energy.
Ocean currents and movements	Negligible and temporary impacts outside immediate vicinity of wind facilities.	Reduction in wave height and energy could be observed within 2 km (1.2 mi) of a facility; no measurable onshore impacts because facilities would be >2 km (1.2 mi) offshore.	For larger facilities (i.e., those causing a decrease in ocean current energy of more than 4% and producing more than 1,000 megawatts [MW] of power), possible adverse impacts to regional climate and ecology. This level of development is not expected over the next 5 to 7 years. Mitigation of impacts could include maximizing the efficiency of extraction systems or limiting the quantity of energy extracted.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Water quality	Possible minor impacts from small spills of fuel, lubricants, solvents, etc., and resuspension of sediments during construction/operation/decommissioning (especially if facility is located in area with contaminated sediments). Negligible impacts from use of antifouling coatings if used according to regulations. Moderate to major impacts if large fuel or lubricating oil or dielectric fluid spills result from collisions with facility structures or from failure of electric service platforms. Mitigation measures include: use of environmentally friendly chemicals (e.g., drilling fluids, antifouling coatings); adherence to spill prevention, control, and countermeasure plans; creation of exclusion zones for commercial and/or recreational vessels; and siting away from contaminated areas.	Same as for wind energy, except that pile driving or drilling would be limited or would not occur at all, so that impacts from sediment resuspension and use of drilling fluids would be lower. Also, spills of dielectric fluid would be small due to lower quantities used than for wind energy.	Same as for wind energy (certain technologies would require driving or drilling of monopiles, others would not). Also, spills of dielectric fluid would be small due to lower quantities used.
Acoustic environment	Construction and decommissioning could generate high-intensity noise (e.g., from pile driving or drilling, laying cable in bedrock, removal of pilings with explosives), causing minor to moderate impacts to aquatic biota. Mitigation measures include: (e.g., reducing sound emissions using bubble curtains or insulated piles, cutting pilings rather than using explosives) can decrease impacts. Operational noise impacts depend on distance from receptors and are expected to be minor.	Construction and decommissioning noise sources and impacts same as for wind energy, except that pile driving or drilling would be much more limited. Highest level of operational noise expected from terminators, however, impacts remain minor. Attenuators and point absorbers would generate noise similar to boats of similar size—minor impacts.	Construction and decommissioning noise sources and impacts same as for wind energy, except that pile driving or drilling would be more limited. Low operational noise levels; minor impacts.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Hazardous materials and waste management	Minor to moderate impacts from spills during testing, site characterization, construction, operation, and decommissioning. Moderate to major impacts if large fuel or lubricating oil or dielectric fluid spills result from collisions with facility structures or from failure of electric service platforms. Mitigation measures include: development of hazardous materials and waste management plans, development of spill prevention and response plans, use of environmentally friendly chemicals where feasible, and consultation to ensure that facilities are not sited in the immediate vicinity of chemical weapons disposal areas.	Same as for wind energy. Also, spills of dielectric fluid would be small due to lower quantities used.	Same as for wind energy. Also, spills of dielectric fluid would be small due to lower quantities used.
Electromagnetic fields	Negligible to minor impacts to human health or marine organisms.	Negligible to minor impacts to human health or marine organisms.	Negligible to minor impacts to human health or marine organisms.
Marine mammals	Potential moderate to major impacts to some threatened and endangered species (e.g., North Atlantic right whale) from noise from pile driving or drilling or removal of pilings using explosives, facility avoidance, and from physical injury from vessel strikes. Moderate impacts from operational noise, especially for mammals with feeding/mating areas or migratory routes intersected by facility. Mitigation measures include: avoidance of mating, feeding, and calving areas and migration routes; ceasing construction work when mammals are nearby; adhering to spill prevention and response plans; and cutting pilings rather than using explosives during decommissioning.	Types of impacts similar to those identified for wind energy, although acoustic impacts would be less because pile driving or drilling would be limited. Possible moderate to major impacts to some threatened and endangered species from collisions with or entanglement in moorings.	Same as for wind energy, except more potential moderate to major impacts from turbine strikes or entanglement with moorings. Potential mitigation through siting, use of design features or management measures, use of sonic pingers.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Marine and coastal birds	Minor to moderate impacts from onshore construction of facilities and cable landfalls. Negligible to moderate impacts from offshore construction depending on the habitats and birds affected. Minor to potentially major impacts due to turbine collisions for some threatened and endangered species of marine and coastal birds. Possible major impacts from large spills of fuel or lubricating oils or dielectric fluids. Mitigation measures include: siting to avoid important bird abundance, feeding, nesting, and wintering areas; timing of major noise generating activities to avoid nesting periods; reduction or cessation of operations of turbines in migration paths during peak migration periods; and use of antiperching devices.	Same as for wind energy, but bird strike risk is removed, except possibly for some diving birds (e.g., pelicans and terns) that could collide with structures or mooring lines.	Same as for wind energy, but bird strike risk is removed, except possibly for some diving birds and for short periods when structures are raised from the water for maintenance.
Terrestrial biota	Negligible to moderate impacts during construction of facilities and cable landfalls, and during operation of onshore facilities. Minor to moderate impacts to migrating bats and terrestrial birds from turbine collisions. Possible major impacts from large spills of fuel or lubricating oils or dielectric fluids. Mitigation measures include: siting to avoid onshore facilities in sensitive areas, timing activities to avoid nesting periods, coordination with USFWS, and adhering to spill prevention and response plans.	Same as for wind energy, except no impacts for migratory birds and bats.	Same as for wind energy, except no impacts for migratory birds and bats.
Fish resources and EFH	Negligible to moderate impacts during construction, operation, and decommissioning (most notably from noise from pile driving or drilling and/or removal of structures using explosives). Population-level effects considered unlikely for most fish and shellfish species. Mitigation measures include: avoidance of sensitive fish habitats, cutting pilings rather than using explosives during decommissioning, deterring fish from the area prior to pile driving, decreasing sound emissions, and development of hazardous materials and waste management plans.	Same as for wind energy, although acoustic impacts would be less because pile driving or drilling would be limited. Possible localized impacts on populations for some species from entrainment in WEC devices, depending on their design.	Same as for wind energy, although acoustic impacts would be less because pile driving or drilling would be limited.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Sea turtles	Minor to moderate impacts during testing, site characterization, construction, operation, and decommissioning (most notably from noise from pile driving or drilling, disorientation of hatchlings from onshore lighting, and/or removal of structures using explosives, vessel collisions, and onshore construction). Possible major impacts if nests or aggregates of hatchlings are destroyed. Possible major impacts from large spills of fuel or lubricating oils or dielectric fluids. Impacts from operational noise (wind turbines) unknown. Mitigation measures include: avoidance of onshore nesting areas, ceasing construction work when turtles are within the area, adhering to spill prevention and response plans, and limiting types and size of explosives used. Assuming that mitigation measures are employed, population-level impacts would not be expected.	Same as for wind energy; additional adverse impacts from entrainment in overtopping devices, impediment of movement by terminators and overtopping devices, and entanglement in moorings. Additional mitigation measures include avoiding use of overtopping devices in areas of passive hatchling aggregation and development and use of turtle exclusion devices.	Same as for wind energy, additional moderate adverse impacts from rotor collisions and/or entanglement in moorings, particularly for facilities located between nesting beaches and offshore turtle staging areas, and hatchling aggregation areas. Additional mitigation measures include development and use of turtle exclusion devices.
Coastal habitats	Negligible to moderate impacts during site characterization, construction, operation, and decommissioning from vessel traffic generating waves, accidental fuel spills, dredging, cable-installation, and onshore construction resulting in habitat fragmentation, altered hydrology, loss of barrier beach habitat, and loss of wetlands and marshes. Mitigation measures include: reduced vessel speeds near barrier islands, use of low-impact spill cleanup methods if necessary, avoidance of sensitive coastal habitats (particularly seagrass beds), use of best management practices for erosion and sedimentation control, application of dredged material to marshes, and use of nonintrusive construction techniques.	Same as for wind energy.	Same as for wind energy.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Seafloor habitats	Negligible to minor impacts during testing, site characterization, construction, operation, and decommissioning (most notably from noise from pile driving or drilling, and/or removal of structures using explosives, placement of meteorological towers, and electromagnetic [EM] fields around cables). Potentially major impact to benthic communities from installing facilities on uncommon or sensitive habitat. Mitigation measures include: avoidance of sensitive seafloor habitats, minimizing seafloor disturbance, avoiding use of explosives, and shielding of cables. Assuming mitigation measures are employed, population-level impacts would not be expected.	Same as for wind energy.	Same as for wind energy.
Areas of special concern	Site-specific impacts depend on locations of facilities. Minor to moderate impacts to visual resources if wind towers are visible from coastal parks. Impacts from fuel spills, noise, and construction expected to be minimal assuming that facilities would not be sited in the immediate vicinity of offshore marine protected areas.	Same as for wind energy, except potential impacts to visual resources would be minor.	Same as for wind energy, except potential impacts to visual resources would be negligible.
Military use areas	Negligible to minor impacts during testing, site characterization, construction, operation, and decommissioning, assuming that siting of facilities is coordinated with the USDOD.	Same as for wind energy.	Same as for wind energy.
Transportation	Negligible to minor construction impacts because individual units would be installed sequentially. Negligible to minor impacts during operations; ports and harbors could accommodate additional volume without significant upgrades. Mitigation measures include: use of signage and/or lighting to mitigate potential marine navigation and aviation hazards due to height of towers; also, siting away from significant flight paths.	Same as for wind energy, except no aviation hazards would be expected.	Same as for wind energy, except no aviation hazards would be expected.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Socioeconomic resources	Site-specific impacts depend on size of population in area where facility is sited. However, direct and indirect impacts on employment would likely be minor, especially in mid-sized populations or densely populated coastal locations typical of the study areas. Site-specific sociocultural impacts unknown; could range from negligible to moderate. Environmental justice impacts are site-specific and would be assessed for specific projects.	Same as for wind energy.	Same as for wind energy.
Cultural resources	Site-specific potential negligible to moderate impacts associated with disturbance of sites; surveys would be required in areas with potential to contain intact cultural resources. Mitigation measures include: avoidance of locations with high potential for shipwrecks or submerged prehistoric sites, based on survey data.	Same as for wind energy.	Same as for wind energy.
Land use and existing infrastructure	Negligible to minor impacts during testing, site characterization, construction, operation, and decommissioning, assuming that existing uses and proposed plans are identified during siting and public concerns are considered. Onshore construction impacts expected to be negligible. Commercial shipping would be excluded within the facilities, but other uses (e.g., recreation, fishing) would be possible.	Same as for wind energy, except that the density of the WEC units might make the entire surface area of the facility unavailable for other uses.	Same as for wind energy
Visual resources	Site-specific positive or negative impacts dependent on viewers. Mitigation measures include: siting away from sensitive areas.	Site-specific negligible to minor impacts due to low height of structures.	Site-specific negligible impacts due to low height of structures.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Tourism and recreation	Minor impacts during testing, site characterization, construction, operation, and decommissioning for beach recreation, sightseeing, diving, and recreational fishing; site-specific impacts due to presence, height, and visibility of structures. Mitigation measures include: siting away from sensitive areas.	Negligible site-specific impacts during each development phase for beach recreation and sightseeing due to low height and low visibility of structures; minor site-specific impacts for diving and recreational fishing due to presence of structures. Mitigation through siting away from sensitive areas	Negligible site-specific impacts during each development phase for beach recreation and sightseeing due to low height and low visibility of structures; minor site-specific impacts for diving and recreational fishing due to presence of structures. Mitigation through siting away from sensitive areas
Fisheries	Site-specific potential negligible to moderate impacts due to decreased catchability, decreased access to fishing areas, and damage or loss of equipment or vessels. Mitigation measures include: avoidance of high-use fishing areas, review of plans with potentially affected fishing organizations and port authorities, conducting noise-generating activities during closed fishing periods, and sufficient lighting of facility structures.	Same as for wind energy.	Same as for wind energy.
Nonroutine conditions	Possible occupational injuries or fatalities, particularly from working at heights and working over water. Relatively low potential number of human casualties from collisions, natural events, or sabotage/terrorism. Site-specific potential moderate to major impacts to marine resources from large spills due to collisions, natural events, or sabotage/terrorism. Mitigation measures include: use of navigational aids, adherence to U.S. Coast Guard–approved plans, and adherence to spill prevention and response plans.	Same as for wind energy.	Same as for wind energy.

- **Water quality:** Minor impacts from small spills of fuels, lubricants, solvents, etc., and resuspension of sediments during construction/operation/ decommissioning (especially if the facility is in an area with contaminated sediments). Moderate to major impacts possible if large spills occur due to collisions with facility structures or to failure of electric service platforms during storms.

- **Acoustic environment:** Temporary increased noise levels from the driving or drilling of monopiles, the laying of cable, and/or the use of explosives. Potential increase in noise from wind, wave, and current devices would depend on design criteria.

- **Hazardous materials and waste management:** Minor to moderate impacts from potential spills of fuels, lubricants, dielectric fluids, etc.

- **Electromagnetic fields (EMFs):** Negligible to minor impacts to human health or marine organisms from exposures to low-level EMFs.

- **Marine mammals:** Possible moderate impacts for threatened and endangered marine mammals from construction and operational noise, vessel strikes, collisions with rotors from ocean current facilities, and entanglement in wave energy conversion (WEC) moorings (increased risk if structure density is high). Potential major impacts to threatened or endangered marine mammals whose population levels are low (e.g., North Atlantic right whale).

- **Marine and coastal birds:** Possible moderate impacts for threatened and endangered bird species and migratory species that fly over wind facilities, from collisions with wind turbines (or with rotors from ocean current facilities for diving birds), particularly if turbines are located in migration path (increased risk if structure density is high). Possible moderate impacts due to habitat disturbance during onshore and offshore construction activities—these impacts could be major for threatened and endangered species whose population levels are low. Possible major impacts from large spills of fuel or lubricating oils or dielectric fluids.

- **Terrestrial biota:** Negligible to moderate impacts from construction, operation, and decommissioning of onshore facilities, and potential minor to moderate impacts to bats and migratory birds from collisions with wind turbines activities—these impacts could be major for threatened and endangered species whose population levels are low. Possible major impacts from large spills of fuel or lubricating oils or dielectric fluids.

- **Fish resources and Essential Fish Habitat (EFH):** Negligible to moderate impacts from noise (e.g., pile driving or drilling) or the use of explosives; population-level effects unlikely for most species. Potential moderate impacts if wave and current technologies entrain, impinge, or entrap fish and their prey base.

- **Sea turtles:** Minor to moderate impacts from construction noise, onshore construction, onshore lighting, vessel and facility collisions, and entanglement in moorings (increased risk if density of structures is high)—these impacts could be major if turtle nests or aggregates of hatchlings are destroyed. Possible major impacts from large spills of fuel or lubricating oils or dielectric fluids.

- **Coastal habitat:** Minor to moderate impacts from fuel spills. Negligible to moderate impacts from dredging, cable installation, and onshore construction.

- **Seafloor habitat:** Negligible to minor impacts from construction noise and EMFs. Potentially major impacts from installation of a facility on uncommon or sensitive seafloor habitat.

- **Areas of special concern:** Site-specific impacts depending on location. Possible moderate impacts if facilities are sited close to marine-protected or otherwise designated areas.

- **Military use areas:** Negligible to minor impacts assuming that the siting of facilities is coordinated with the U.S. Department of Defense (USDOD).

- **Transportation:** Negligible to minor impacts because ports and harbors could accommodate additional volumes.

- **Socioeconomic resources:** Site-specific impacts depend on the size of the population in the area where the facility is sited. Possible negligible to moderate sociocultural impacts.

- **Cultural resources:** Site-specific potential negligible to moderate impacts from disturbance of intact sites.

- **Land use and existing infrastructure:** Potential negligible to minor impacts from commercial shipping, fishing, or recreational use restrictions.

- **Visual resources:** Site-specific impacts from wind facilities; perception of impacts may be positive or negative for different viewers. Negligible to minor impacts from wave and ocean current facilities.

- **Tourism and recreation:** Minor impacts to beach recreation, sightseeing, diving, and recreational fishing.

- **Fisheries:** Negligible to moderate impacts through decreased catchability of fish, decreased access to fishing areas, and damage or loss of equipment or vessels.

- **Nonroutine conditions:** Site-specific, potential moderate to major impacts from large spills. Possible occupational injuries or fatalities. Relatively low potential number of human casualties because of generally low numbers of personnel present at alternative energy facilities.

In Chapter 5, for each area of potential adverse impact, specific mitigation actions are recommended. Most adverse impacts could be greatly reduced or eliminated by implementation of appropriate mitigating actions. In many cases, the recommended mitigation is to avoid the siting of facilities in areas of special concern or in ecologically sensitive areas. However, many active mitigation measures are also recommended to reduce impacts during construction, operation, and decommissioning of facilities (e.g., noise ramp-up procedures prior to pile driving, use of environmentally friendly chemicals where possible, spill contingency planning, limiting the use of explosives).

Under the proposed action, there would be a national program that establishes a consistent and transparent regulatory framework for granting leases, easements, or ROWs for alternative energy development on the OCS. The MMS would publish proposed regulations that set forth a transparent and efficient process for parties interested in seeking development rights on the OCS. The national program would have consistent standards and practices that would be applied throughout the OCS. These standards and practices could decrease the environmental impacts from alternative energy facilities. For example, the MMS AEAU Program would establish policies and best management practices (BMP) that would be uniformly applied to comparable projects across the OCS (see Section 2.7.2).

7.1.2 Alternate Use of Oil and Gas Platforms

Impacts from alternate use of existing oil and gas platforms include fisheries enhancement and economic benefits to both platform operators and government agencies involved in natural resource protection. Platform removal is costly. Removal costs can be reduced by finding alternate uses for platforms. As discussed in Chapter 6, removal of a platform structure from the OCS would result in destruction of the ecological system developed around the invertebrate species and plant life that envelop a platform's structure after emplacement. This ecological system includes smaller fish feeding on plant life up to other marine life, including mammals and predator fish feeding off the smaller fish species, resulting in enhanced recreational and commercial fishing opportunities. With proper implementation, alternate uses of oil and gas platforms are expected to result in negligible to minor impacts.

Alternative Energy Production—Incorporating an existing oil and gas platform into an energy-related or marine-related project would not only provide cost savings to platform operators and mitigate any removal impacts; it would also reduce impacts to the environment because existing facilities or structures would be used for the proposed activity instead of installing new ones on the OCS, the usual benefit of recycling. In addition, emissions related to other energy sources would be reduced as discussed in Section 7.5, as would disturbances to seafloor habitats and noise impacts from pile-driving activities, as discussed in Chapter 5. If the existing structure has a power cable connection to onshore facilities that is appropriate for transmitting the generated power onshore, then cable installation impacts could also be avoided.

Research and Monitoring—Similar cost savings and removal and installation impacts could be avoided if an existing oil and gas platform were converted for use as a base for research or monitoring. Such activities would not be expected to increase vessel traffic or cause other more disruptive impacts on the environment compared to the previous oil and gas exploration or production activities.

Aquaculture—As for other alternate uses, structure removal and installation impacts could be avoided if a platform is converted for use as an aquaculture facility. Aquaculture is a growing source of food for the nation as commercial fish harvests are limited by dwindling fish populations in the oceans. However, careful planning and operation of such facilities would be necessary to avoid moderate impacts such as pollution problems associated with feed and medication materials and cultured species waste. Other potential problems that would need attention include interference with native fish populations and predators.

7.2 IMPACTS OF THE CASE-BY-CASE ALTERNATIVE

Under the case-by-case alternative, the MMS would evaluate individual project proposals for alternative energy or alternate use as they were submitted to the MMS. The alternative energy and alternate use activities that would be the subject of approvals under both the proposed action and the case-by-case alternative are the same. What differs is the process by which the MMS would approve such activities. The case-by-case alternative would have minimal administrative rules. The evaluation of alternative energy or alternate use project proposals by the MMS would be performed pursuant to nationwide guidelines and informed by BMPs. For example, the potential impacts from alternative energy facilities summarized in Section 7.1 would be the same or similar for similar facilities approved under the case-by-case alternative. Also, if alternate uses are proposed and permitted, the proposals would be evaluated and approved on a case-by-case basis, and the impacts would be the same or similar to those discussed in Chapter 6.

Under the case-by-case alternative, approvals of such applications could potentially vary among MMS regional offices and could be processed at a slower pace due to less certainty in the absence of clear, consistent formal regulations. The environmental impacts would still, however, be the same or similar to the impacts discussed under the proposed action.

7.3 IMPACTS OF THE NO ACTION ALTERNATIVE

Analysis of a no action alternative is required under NEPA. Under the no action alternative, the MMS would not authorize alternative energy and alternate use activities on the OCS.

Potentially significant offshore alternative energy resources in the United States would remain largely unexploited (although individual States could still authorize development of offshore energy resources on State submerged lands) should the MMS chose not to approve applications to develop alternative energy projects on the Federal OCS. Assessments of the amount of potential alternative energy available and the technological and economic feasibility of producing alternative energy on the OCS would also be reduced or discontinued. In addition, research and development of alternative energy technologies on the OCS would likely be reduced or discontinued. This could result in several adverse impacts, including: (1) the loss of a potentially significant option for meeting U.S. energy demand, and (2) the lessening of U.S. competitiveness in alternative energy technology development and implementation. In turn, the impacts from coal, nuclear, and natural gas usage to satisfy expanding energy demand could increase, as could imports of liquefied natural gas (LNG), which could further U.S. dependence on foreign sources of energy. The potential adverse impacts associated with electricity produced from other sources (e.g., coal-fired power plants or natural gas–fired plants) are discussed in Section 7.5. Although the magnitude of such adverse impacts under the no action alternative is not known, because the number of inquiries regarding leases, easements, and ROWs for new alternative energy projects on the OCS is increasing, the likelihood of these adverse impacts is also increasing.

In addition, under the no action alternative, there would be many fewer opportunities to employ existing oil and gas facilities located on the OCS for alternate uses. The impacts of this loss would be to limit the research, development, and implementation of other potentially beneficial alternate uses of these structures. Only activities authorized under other provisions of the OCSLA, the Deepwater Port Act of 1974 (33 USC 1501 et seq.), the Ocean Thermal Energy Conversion Act of 1980 (42 USC 9101 et seq.), or other applicable laws could be approved for existing facilities on the OCS should alternate use activities not be authorized under new subsection 8(p) of the OCSLA (Section 388 of the Energy Policy Act of 2005 [EPAct]). Absent an approved alternate use, OCS oil and gas facilities would have to comply with the existing requirements under 30 CFR 250, Subpart Q, Decommissioning Activities.

7.4 IMPACTS OF THE PREFERRED ALTERNATIVE

The preferred alternative combines elements of the proposed action and the case-by-case alternative. The alternative energy and alternate use activities that would be the subject of approvals under the preferred alternative, the proposed action, and the case-by-case alternative are the same. What differs is the process by which the MMS would approve such activities.

The selection of this combination provides the MMS flexibility to manage the issuance of leases, easements, and ROWs for alternative energy and alternate use activities. The combination of the proposed action and case-by-case alternative limits possible impacts associated with further delay in tapping the energy potential of alternative energy projects on the Federal OCS by allowing applications to be approved by the MMS before full implementation of the final regulations, but keeps the MMS on course for a comprehensive program governed by regulations. Leases, rights-of-use and easement (RUEs), and ROWs issued under the preferred alternative prior to the completion of rulemaking would be subject to project-specific NEPA analyses and would include terms, conditions, and stipulations that ensure safe and environmentally responsible operations on the OCS in a manner consistent with the provisions of the final implementing regulations. The MMS would rely on the BMPs and other policies and practices discussed in this programmatic EIS to develop necessary mitigation measures for specific projects and to inform the approval process of individual leases and grants issued on a case-by-case basis. Upon promulgation of the final rule, all leases, RUEs, and ROWs for alternative energy and alternate use activities would be issued subject to its comprehensive provisions. Impacts from the preferred alternative would be the same as or similar to those from the case-by-case alternative prior to promulgation of the final rule. Following promulgation of the final rule, the impacts would be the same as or similar to those from the proposed action.

7.5 IMPACTS OF OTHER ENERGY SOURCES

In the event that the MMS elected not to consider proposals for alternative energy development and did not develop the AEAU Program, or if there were no proposals to develop alternative energy resources on the OCS, increased demands on electricity supply would have to be met by energy conservation and/or increased efficiency of existing sources and loads (e.g., appliances) and/or by increasing the contribution from other sources, including electricity from fossil fuels, nuclear fuels, and other land-based generation systems (e.g., hydro, wind, solar, geothermal). This section provides a broad overview of the potential environmental impacts associated with such energy sources.

The nature of the environmental impacts from other energy sources would depend on the fuel source, type of energy generation technology selected, size of the facility, location, and facility age (if pre-existing). Potential environmental impacts for other energy sources are discussed generically in this section because specific locations for alternative energy projects are not being proposed at this time.

The Energy Information Administration (EIA), a component of the U.S. Department of Energy (USDOE), issues an Annual Energy Outlook each year. In *Annual Energy Outlook 2006 with Projections to 2030* (EIA 2006), the EIA projects that new electrical generating capacity will include a mix of generating technologies. Of the new generating capacity to be added over the period 2004 to 2030, coal-fired plants are projected to account for 50%, natural gas–fired plants 40%, renewable technologies (primarily wind, biomass, and geothermal) 8%, and nuclear 2%. The EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize costs while meeting applicable environmental requirements.

Based on the projected mix of future electrical generating capacity, this section considers the following power-generation alternatives:

- Coal-fired plant generation (Section 7.5.1);
- Natural gas–fired plant generation (Section 7.5.2);
- Nuclear power plant generation (Section 7.5.3);

- Other land-based generation systems, including hydro, onshore wind, solar, geothermal, biomass, municipal solid waste, and fuel cells (Section 7.5.4); and

- Energy efficiency and conservation (Section 7.5.5).

The order of presentation in this section does not suggest which alternatives would be most likely to occur or to have the fewest environmental impacts. Decisions to add electrical capacity depend on the costs and operating efficiencies of the different generating options available, fuel prices, and the availability of Federal investment tax credits. In most instances, the energy sources considered in this section are well-established technologies.

7.5.1 Coal-Fired Plant Generation

Coal-fired electric plants provide most of the electricity-generating capacity in the United States, accounting for about 50% of the electric utility industry's net generation in 2004 (EIA 2006). The coal share is projected to remain fairly stable through 2020, before increasing to 57% in 2030 (EIA 2006). Conventional coal-fired plants generally include two or more generating units and have total capacities ranging from 100 megawatts (electric) (MW[e]) to more than 2,000 MW(e). The United States has abundant low-cost coal reserves, and the price of coal for electricity generation is likely to increase at a relatively slow rate.

The environmental impacts of constructing a typical coal-fired steam plant are well known, because coal is the most prevalent type of central generating technology in the United States. The impacts of constructing a 1,000-MW(e) coal plant at a greenfield site can be substantial, particularly if it is sited in a rural area with considerable natural habitat (U.S. Nuclear Regulatory Commission 1996). An estimated 700 hectares (ha) (1,700 acres) would be needed, and this could amount to the loss of about 8 km^2 (3 mi^2) of natural habitat and/or agricultural land for the plant site alone, excluding that required for mining and other fuel-cycle impacts (U.S. Nuclear Regulatory Commission 1996). Ecological impacts could be major, and important cultural sites could be encountered, particularly near rivers. With this much land being cleared, some erosion and sedimentation would be expected. Considerable amounts of fugitive dust would affect air quality temporarily, and the quantity of construction debris would be substantial. Aesthetic impacts from such a large construction effort in a rural area could also be substantial.

During construction, socioeconomic impacts at a rural site would be larger than at an urban site because more of the 1,200–2,500 peak workforce would need to move to the area to work (U.S. Nuclear Regulatory Commission 1996). Such impacts are greatest at very remote sites where accommodations may be nonexistent and the large majority of workers must move to the area to build the plant. Construction of transmission lines would add to virtually all these impacts. Siting a new coal-fired plant where an existing power plant is located would reduce many construction impacts, thereby reducing the initial damage to the environment and minimizing the need for new transmission lines. Such collocation would depend on factors such as location of load centers, environmental restrictions, and site characteristics.

Operating impacts of new coal plants would be substantial for several resources. Concerns over adverse human health effects from coal combustion have led to important Federal legislation in recent years, such as the Clean Air Act (CAA). Air quality would be impacted by the release of carbon dioxide (CO_2), regulated pollutants, and radionuclides. Public health risks such as cancer and emphysema are considered likely results. CO_2 has been identified as a leading cause of global warming. SO_2 and oxides of nitrogen have been associated with acid rain. In addition, mercury emissions from coal-fired plants are a growing concern. In December 2000, the U.S. Environmental Protection Agency (USEPA) issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (USEPA 2000a). The USEPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. The USEPA found that coal-fired power plants emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (USEPA 2000a). The USEPA concluded that mercury is the hazardous air pollutant of greatest concern. Accordingly, on May 18, 2005, the USEPA issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants (USEPA 2005).

Operation of a new coal plant would result in impacts other than air emissions. Substantial solid waste, especially fly ash and scrubber sludge, would be produced and require continual management. Losses to aquatic biota would occur through impingement and entrainment and discharge of cooling water to natural water bodies. Socioeconomic benefits can be considerable for surrounding communities in the form of increased employment, substantial increase in tax revenues, and plant spending.

With coal-fired plants, there are worker risks associated with fuel and limestone mining, fuel and lime transportation, and disposal of coal combustion waste. In addition, there are public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal-fired plant alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In addition to the impacts discussed above, impacts would occur as a result of the mining and transportation of coal and limestone. An estimated 8,900 ha (22,000 acres) for mining the coal and disposing of the waste could be committed to supporting a coal plant during its operational life (Nuclear Regulatory Commission 1996). Impacts of mining operations would include an increase in fugitive dust emissions; surface-water runoff; erosion; sedimentation; changes in water quality; disturbance of vegetation and wildlife; disturbance of historic and cultural resources; changes in land use; and impacts on employment. Transportation of coal and limestone also result in air emissions. Socioeconomic benefits from increased employment and increased tax revenues would also accompany any increase in coal mining.

7.5.2 Natural Gas–Fired Plant Generation

Natural gas supplied 18% of this country’s net electric utility generation in 2004 and is projected to supply 22% of electricity in 2020 (EIA 2006). Although natural gas reserves are fairly large, much of the resource is located in remote areas that are not served by a pipeline infrastructure connected to high-demand centers. Utilities receive gas at power plants through pipelines on a continuous basis.

Natural gas is used in three technologies: conventional steam, gas-turbine, and combined-cycle. In conventional steam plants, the traditional gas-fired technology, natural gas is burned to produce steam. The process is very similar to that used for coal and oil technologies. Because natural gas can be used more efficiently in gas-turbine and combined-cycle facilities than in a conventional steam plant, the latter technology is no longer being used for new generating stations. In gas-turbine plants, gas (or distillate oil) is burned to produce an exhaust gas that drives the turbine. Combined-cycle plants, which are particularly efficient and are used as intermediate and baseload facilities, combine the gas-turbine technology with a heat recovery system that powers a steam cycle. In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity. Combined-cycle systems represent the large majority of the new and planned gas-fired plants in the United States. Most of the plants are small and have proved to be popular with independent power producers.

Land-use requirements for gas-fired plants are smaller than for coal-fired plants at 45 ha (110 acres) for a 1,000-MW(e) plant; thus, land-dependent ecological, aesthetic, erosion, and cultural impacts would be comparably less unless site-specific factors indicate a particular sensitivity for some environmental resource (U.S. Nuclear Regulatory Commission 1996). Most environmental impacts of constructing natural gas–fired plants would be approximately the same for steam, gas-turbine, and combined-cycle plants. These impacts are generally similar to those of other large, central generating stations.

Construction of the transmission line and construction and/or upgrading of the gas pipeline to serve the plant would be expected to have impacts as well, depending on the exact locations.

Collocating the gas-fired plant with an existing generating plant would help reduce land-related impacts. Socioeconomic impacts would not be very noticeable because the highest peak workforce of 1,200 for steam plants is small for a central generating technology, and gas-fired plants are not usually sited in remote areas where community impacts would be most adverse. Also, gas-fired plants, particularly combined cycle and gas turbine, take much less time to construct than other plants.

The environmental impacts of operating gas-fired plants are generally less than those of other fossil fuel technologies of equal capacity. Consumptive water use is about the same for steam plants as for other technologies. Combined-cycle plants would require relatively small quantities of cooling water compared with the coal-fired plant alternative. There are potential impacts to aquatic biota through impingement and entrainment and increased water temperatures in receiving water bodies. The workforce would be the lowest of any nonrenewable technology, as would local purchases and local tax revenues.

Natural gas is a relatively clean-burning fuel. The gas-fired plant alternative would release CO_2 and nitrogen oxides (NO_x), but in lesser quantities than the coal-fired plant alternative. Methane (CH_4), a primary component of natural gas and a greenhouse gas, can also be emitted when natural gas is not burned completely. Methane can also be emitted as a result of leaks and losses during transportation. Generally, air quality impacts for all natural gas technologies are less than those for other fossil technologies because fewer pollutants are emitted, and SO_2, a contributor to acid precipitation, is not emitted at all. In December 2000, the USEPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (USEPA 2000a). The USEPA found that natural gas–fired power plants emit arsenic, formaldehyde, and nickel (USEPA 2000a). The USEPA did not determine that emissions of hazardous air pollutants from natural gas–fired power plants should be regulated under Section 112 of the CAA as are those of coal- and oil-fired plants.

Impacts from solid waste management at natural gas–plants are generally minimal. There would be spent catalyst from NO_x emissions control and small amounts of solid waste products (i.e., ash) from the burning of natural gas fuel. Natural gas combustion results in very few by-products because of the clean nature of the fuel. Waste-generation impacts would be so minor that they would not noticeably alter any important resource attribute.

Environmental impacts would also result from the production and transportation of natural gas. Natural gas is often found mixed with oil, or floating on top of underground reservoirs of oil. Natural gas production can result in the release of CH_4 to the atmosphere, oil spills, and produced water (saline or brackish water generated during oil and gas production). For a 1,000-MW natural gas power plant, approximately 1,500 ha (3,600 acres) of additional land would be required for wells, collection stations, and pipelines to bring the natural gas to the generating facility (U.S. Nuclear Regulatory Commission 1996). Impacts would be typical of those associated with land clearance. Use of natural gas also results in the loss of a nonrenewable resource.

7.5.3 Nuclear Power Plant Generation

Nuclear power supplied 20% of this country's net electric utility generation in 2004. Nuclear capacity is expected to increase, through power uprates at existing nuclear plants as well as the construction of new plants. Although nuclear capacity is expected to increase, it is projected to account for only 15% of total U.S. generation in 2030 (EIA 2006).

Since 1997, the U.S. Nuclear Regulatory Commission has certified four new standard designs for nuclear power plants, all of which are light-water reactors (LWRs). Although no applications for a construction permit or a combined license based on these certified designs have been submitted to the U.S. Nuclear Regulatory Commission, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants in the United States. In addition, recent escalation in prices of natural gas and electricity has made new nuclear power plant construction more attractive. Future plants using the advanced LWR technology are expected to require smaller sites and shorter construction periods than current nuclear plants.

The environmental impacts of constructing an advanced LWR nuclear plant are expected to be equivalent to the impacts of building any large energy facility, such as a coal-fired facility. Impacts could be moderated somewhat if the plant were built at a current nuclear plant site rather than at a greenfield site because the prevailing land use would be compatible at the former site. Thus, building a plant on a greenfield site would produce more severe impacts (U.S. Nuclear Regulatory Commission 1996).

The impacts of constructing a nuclear plant at a greenfield site can be substantial, particularly if the plant is sited in a rural area with considerable natural habitat (U.S. Nuclear Regulatory Commission 1996). Advanced LWRs will require on the order of 200 to 400 ha (500 to 1,000 acres), excluding transmission lines, which could add hundreds to thousands of hectares depending on the distance of the plant from connecting transmission lines or load centers. Ecological impacts could be large, and important cultural sites could be encountered, particularly near rivers. With this much land being cleared, some erosion and sedimentation would be expected. Considerable fugitive dust emissions would affect air quality temporarily, and the quantity of construction debris also would be substantial. Aesthetic impacts from such a large construction effort in a rural area could be substantial.

During construction, socioeconomic impacts at a rural site would be larger than at an urban site because more of the workforce would need to move to the area to work (U.S. Nuclear Regulatory Commission 1996). Such impacts are worst at very remote sites where accommodations may be nonexistent and the large majority of workers must move to work on the plant. Transmission line impacts would add to virtually all these impacts.

The environmental impacts of operating new nuclear plants are expected to be similar to those of operating current nuclear plants except that slightly more radioactive waste would be generated and the potential for accidents would be reduced somewhat. The newer technology would have built-in safety features that would shut down the plant automatically and use natural forces to greatly reduce the possibility of severe accidents. Socioeconomic benefits for local communities normally associated with large energy facilities, including substantial employment, tax revenues, and local purchases, would also result.

Nuclear plants can have significant impact on water resources due to cooling requirements. The impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. An operating nuclear plant would have minor air emissions associated with diesel generators and other minor intermittent sources.

Approximately 400 additional ha (1,000 acres) would be committed to uranium mining and processing during the life of a new nuclear plant (U.S. Nuclear Regulatory Commission 1996). Impacts of mining would include an increase in fugitive dust emissions, surface-water runoff, erosion, sedimentation, changes in water quality, disturbance of vegetation and wildlife, disturbance of historic and cultural resources, changes in land use, and impacts on employment. The magnitude of these offsite impacts would be largely proportional to the amount of land affected by mining.

Considerable uncertainty remains on the disposal of highly radioactive spent nuclear fuel generated by nuclear power plants. On February 15, 2002, on the basis of a recommendation by the Secretary of the Department of Energy, the President recommended a site at Yucca Mountain, Nevada, for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The U.S. Congress approved this recommendation on July 9, 2002, and the USDOE is in the process of preparing the license application for construction and operation to be submitted to the U.S. Nuclear Regulatory Commission.

7.5.4 Other Land-Based Generation Systems

7.5.4.1 Hydropower

Conventional hydropower plants range in size from several hundred kilowatts to several thousand megawatts (NREL 2005). Source water may be from free-flowing rivers, streams, and canals, or water released from upstream storage reservoirs. Currently, the largest electricity contribution from renewable resources is from hydropower. In 2004, renewable technologies accounted for 9.0% of the total electrical generation in the United States, with hydropower accounting for 6.8% of the total (EIA 2006). Although hydropower is projected to remain the largest source of renewable generation through 2030, its share of total generation is expected to fall to 5% because of the lack of untapped large-scale sites, coupled with environmental concerns (EIA 2006).

Existing hydropower generation is declining because of a combination of real and perceived environmental problems, regulatory pressures, and changes in energy economics (NREL 2005). Consequently, potential hydropower resources are not being currently developed (NREL 2005). However, improvements and efficiency measures in dam structures, turbines, generators, substations, transmission lines, and systems operation are expected to sustain hydropower’s role as a renewable energy source. It is estimated that advanced hydropower products can be applied at more than 80% of existing hydropower facilities (NREL 2005).

Although the amount varies, large-scale hydroelectric plants of 1,000 MW(e) or greater require an average of almost 400,000 ha (1 million acres). Additional land would be required for transmission lines. Wildlife habitat would be lost for terrestrial and free-flowing aquatic biota, and additional habitat would be created for some aquatic species. Associated with the loss of land would be some erosion, sedimentation, dust, equipment exhaust, debris from land clearing, probable loss of cultural artifacts, and aesthetic impacts from land clearing and excavating. The construction workforce would be fairly large, and socioeconomic impacts likely would be substantial, especially if the dam were constructed in a remote area where in-migrating workers would burden local public services (U.S. Nuclear Regulatory Commission 1996).

Operating impacts from hydroelectric dams are associated predominantly with land and water resources. Land that once was lived on, farmed, ranched, forested, hunted, or mined would be submerged under water indefinitely. The original land uses would be replaced by electricity generation and recreation and, perhaps, residential and business developments that take advantage of the lake environment. Changes in water temperature, currents, and amount of sedimentation would produce a different aquatic environment above and below the dam. Alterations to terrestrial and aquatic habitats could change the risks to threatened and endangered species. Although the hydroelectric dam would create no air quality or solid waste impacts during operation and could serve as a protector of property and lives in preventing floods, lake recreation would likely bring with it a number of drownings and cause water pollution during the facility's operation.

7.5.4.2 Onshore Wind

In 2004, electrical generation from onshore wind power accounted for 0.4% of the total U.S. generation, and it is expected to grow to 1.1% by 2030 (EIA 2006). There is considerable uncertainty about the growth potential of wind power, which depends on fossil fuel costs, State renewable energy programs, technology improvements, access to transmission grids, and public concerns about environmental impacts (EIA 2006).

USDOE's National Renewable Energy Laboratory (NREL) estimates that the footprint of a 1.5-MW wind turbine is between 0.25 and 0.5 acres. In addition, a spacing interval of 5 to 10 turbine rotor diameters between wind turbines is typically maintained to prevent interferences between turbines (NREL 2006). Land disturbance during construction to install the turbine is estimated to be between 1 to 3 acres per turbine related to grading the site for installation, laydown areas for equipment and materials, and staging areas for construction equipment used to hoist the turbines and their towers into place. The area surrounding the turbine is then reclaimed after construction is completed. These estimates do not include land used for substations, control buildings, access roads, and other related facilities.

Wind facilities can require substantial land areas. Assuming that the largest available land-based turbine is used (currently, 1.5 MW), about 400 turbines are estimated to produce about 600 MW(e) with the use of the NREL's Wind Farm Area Calculator (NREL 2006). The total acreage for a wind facility with 400 turbines in optimal wind conditions could require more than 2,000 acres; about 200 acres would be dedicated to the turbine footprint (assuming approximately 0.5 acres per turbine base), and the remaining land between turbines could be available for other uses, such as grazing or agricultural land. These numbers do not take into account the low annual capacity factor of approximately 30% that is associated with wind energy.

According to a recent Department of the Interior EIS on onshore wind energy, potential adverse impacts on natural and cultural resources could occur during each phase of wind energy development (i.e., site monitoring and testing, construction, operation, and decommissioning) if effective mitigation measures are not implemented (USDOI 2005). The nature and magnitude of these impacts would vary by phase and would be determined by the project location and size. Potential direct impacts would include use of geologic and water resources; creation or increase of geologic hazards or soil erosion; water quality degradation; localized generation of airborne dust; generation of noise; alteration or degradation of wildlife habitat or sensitive or unique habitat; interference with resident or migratory fish or wildlife species, including protected species; alteration or degradation of plant communities, including the occurrence of invasive vegetation; land use changes; alteration of visual resources; release of hazardous materials or wastes; increased traffic; increased human health and safety hazards; and destruction or loss of paleontological or cultural resources. More limited, potential indirect impacts also could occur to cultural and ecological resources.

The projected impacts of operating wind energy facilities are less than those expected from construction. Wind facilities would have little effect on water and air quality and would generate very little waste. The potential impacts of wind energy development on local and regional economies would be largely beneficial, depending on the size of the project and the resultant wind power capacity.

7.5.4.3 Onshore Solar

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar technologies accounted for less than 0.1% of total U.S. electrical generation in 2004 (EIA 2006). Because of the high cost of solar technologies compared to other conventional systems, solar electrical generation is projected to continue to contribute about 0.1% of the total U.S. generation through 2030 (EIA 2006).

There are two basic types of solar technologies: photovoltaic (PV) cells and thermal conversion systems. Photovoltaic cells, or solar cells, are semiconductor devices that convert sunlight into direct current (DC) electricity. Groups of PV cells are electrically configured into modules and arrays, and the current can be converted to alternating current (AC) with the appropriate equipment. Solar thermal conversion systems use reflective materials to concentrate sunlight to heat a fluid that runs a turbine. Power production from solar systems is proportional to the amount of solar radiation received in a specific geographic area. Research is continuing on a number of solar technologies—both direct conversion and thermal conversion—that could substantially improve the efficiency or reduce the cost of producing electricity from sunlight.

Solar generating systems can be used for either centralized or distributed power generation. PV systems offer application flexibility, have no moving parts, are modular, and are easily expandable. A large demonstration thermal conversion system with a capacity of 350 MW(e) has operated in California since the early 1990s, although not at competitive electrical costs (NREL 2006).

Solar-powered electricity generation on a small scale has relatively minor environmental impacts. For larger scale facilities, surface area requirements for solar systems can be substantial, resulting in potentially significant environmental impacts during construction. It is estimated that land requirements for a 1,000 MW(e) facility would be up to 35,000 acres for a PV system and approximately 14,000 acres for solar thermal systems (U.S. Nuclear Regulatory Commission 1996). Because of the large land areas required, ecological impacts could be large, and important cultural sites could be encountered. With this much land being cleared, some erosion and sedimentation would be expected. Considerable fugitive dust emissions would affect air quality temporarily. Aesthetic impacts from such a large construction effort in a rural area could be substantial.

During operations, solar systems have few operating impacts. Impacts to air quality, human health, solid waste, and cultural resources are expected to be minimal. Water quality would not be affected unless water were used as a cooling agent in an arid environment where it is in short supply, or water runoff from the collectors was uncontrolled and sedimentation damaged water bodies. Socioeconomic benefits would be small compared with those going to host communities of large nonrenewable generating stations. Workforces and local purchases would be small. However, the likely high cost—and high assessed value—of solar thermal facilities could lead to substantial property tax revenues.

There are concerns with the disposal of some PV modules at the end of their useful lifetimes. Some PV modules can contain cadmium or lead (primarily in solder), elements that can exhibit hazardous characteristics. It is possible that end-of-life PV modules may be classified as "hazardous waste," under U.S. national regulations, or under State regulations (Eberspacher and Fthenakis 1997). However, the waste classification depends on the specific PV module design.

7.5.4.4 Onshore Geothermal

Geothermal energy facilities utilize thermal energy within the earth, using hot water and steam to produce electricity or supply direct heat. Geothermal energy has limited geographic availability, with most suitable sites restricted mainly to Nevada and California. In 2004, geothermal facilities accounted for 0.4% of U.S. electrical generation (EIA 2006). This fraction is projected to rise to 0.9% by 2030 (EIA 2006).

A geothermal electricity-generating facility consists of a conversion well that brings the geothermal resources to the surface, the conversion system that produces useful energy from the resource, and the injection well that recycles cooled brine back to the underground reservoir. The maximum size of geothermal power plants is about 110 MW(e) per unit (U.S. Nuclear Regulatory Commission 1996). Geothermal plants, however, could be sited as modular units that would allow for larger generating capacities.

Construction impacts of a geothermal facility would result primarily from disturbance of land to support geothermal wells and the power plant needed to produce electricity. It is estimated that a 1,000-MW(e) plant would require an estimated 2,800 ha (7,000 acres), even though the generating facility or facilities would occupy only around 25 ha (60 acres) (U.S. Nuclear Regulatory Commission 1996). Clearing this land could potentially damage or destroy existing habitat for wildlife, as well as pose potential adverse consequences for cultural resources. Aesthetic impacts would include extensive vegetation removal and earth moving. Some soil erosion and stream sedimentation likely would result from the early clearing operations. Fugitive dust and exhaust fumes from heavy equipment would reduce air quality temporarily. The moderate-sized workforce would create some community impacts, particularly if affected communities were small and had little service infrastructure to accommodate workers who might move to the area to build the plant.

Operating impacts would involve those resources most closely associated with the land disturbed in the construction of the geothermal facility. Some of the land originally cleared for construction could probably be returned to previous uses, since not all of it would be occupied by geothermal facilities. Much acreage would still be lost for the life of the plant, however, and this loss could be complicated by subsidence caused by withdrawal of the geothermal fluid. Loss of habitat, impacts to threatened and endangered species, and visual impacts could be mitigated partially by returning much of the land to, or even leaving it in, its original condition. Surface water and groundwater quality could be impacted adversely if waste fluids from wells escaped into the groundwater or surface streams or ponds. In addition, various toxic gases such as ammonia, CH_4, and hydrogen sulfide and trace amounts of arsenic, borax, mercury, radon, and benzene would be released to the atmosphere. Noise impacts could be a problem for residents living on the edge of a geothermal site. Socioeconomic impacts would be positive, with substantial tax revenues and considerable employment accruing to local taxing jurisdictions.

7.5.4.5 Wood/Biomass

Biomass-based materials, such as wood and agricultural residues, are burned as a fuel for power generation in the electricity sector. The majority of electrical generation utilizing biomass is associated with the pulp and paper industries (Haq 2002). There are power plants that combust biomass exclusively to generate electricity and facilities that mix biomass with coal (biomass cofiring plants). Biomass is the largest source of renewable electricity generation among nonhydropower renewable fuels. Electricity generation from biomass accounted for 0.9% of the total U.S. generation in 2004 and is expected to increase to 1.7% in 2030 (EIA 2006).

Both dedicated biomass and biomass cofiring are used in the electricity generation sector. Biomass cofiring involves combining biomass material with coal in existing coal-fired boilers.

During construction, impacts would be approximately the same as those for a coal-fired plant, although biomass-fired facilities are expected to be built at smaller scales. Like coal-fired plants, biomass plants require large areas for fuel storage and processing and involve the same type of combustion equipment. Construction impacts would be similar to those discussed for coal plants and primarily result from land-clearing activities.

During operations, biomass facilities would have certain environmental advantages compared with coal. Biomass feedstocks have lower levels of sulfur or sulfur compounds (Haq 2002), therefore, substitution of biomass for coal in power plants has the effect of reducing sulfur dioxide (SO_2) emissions. Demonstration tests have shown that biomass cofiring with coal can also lead to lower NO_x emissions. In addition, biomass fueling has the potential to significantly reduce CO_2 emissions (Haq 2002). The major emissions from biomass-fired generation involve the release of particulate matter. However, these emissions are controlled effectively with existing technology. Emissions to land and water resources are associated with soil disturbance and runoff and the disposal of ash. However, ash disposal is not a major concern from biomass combustion, and the ash may be beneficial as a fertilizer and soil conditioner provided the pH is not excessively high (U.S. Nuclear Regulatory Commission 1996).

7.5.4.6 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. There are approximately 89 waste-to-energy plants operating in the United States. These plants generate approximately 2,500 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2004). The combustion process can reduce the volume of waste by up to 90% and the weight of the waste by up to 75% (USEPA 2004d). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (EIA 2001). Mass-burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion.

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills; (2) the 1994 Supreme Court decision (C&A Carbone, Inc. v. Town of Clarkstown), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (EIA 2001).

Municipal solid waste facilities use basically the same steam-turbine technology that would be found at biomass waste facilities. The overall construction impacts are expected to be similar to those of coal-fired power plants in terms of the acreage disturbed. During operations, emissions include particulates, oxides of nitrogen, acid gases, metals, and organic compounds. Odors are also a potential impact from municipal solid waste combustion facilities.

Municipal solid waste combustion generates an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue gases using fabric filters or scrubbers (EIA 2001). One important environmental tradeoff is the decreased landfill requirements and possible improvements in groundwater quality (leachate minimization) at landfills versus decreased air quality from solid waste combustion.

7.5.4.7 Fuel Cells

Fuel cells work without combustion and its environmental impacts. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte (NREL 2005). The only by-products are heat, water, and

CO_2. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. These fuel cells are commercially available at a cost of approximately $4,000 to $4,500/kilowatt (kW) of installed capacity (USDOE 2004a). Higher-temperature second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

It is unlikely that the costs of existing fuel cell systems will drop below $1,000/kW; therefore, the USDOE has formed the Solid State Energy Conversion Alliance (SECA), with the goal of producing new fuel cell technologies at a cost of $400/kW or lower by 2010 (USDOE 2004b). Fuel cells have the potential to become economically competitive if SECA can reach its goal. For comparison, the installed capacity cost for a natural gas–fired, combined-cycle plant is about $500 to $600/kW (Northwest Power Planning Council 2000). At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation (NREL 2005).

7.5.5 Energy Efficiency and Conservation

A nonpolluting alternative to adding electrical capacity through construction of new facilities is the reduction in the amount of energy consumed either through increased efficiency or conservation. Energy efficiency is achieved by using less energy to provide the same energy services. Examples include refrigerators or lightbulbs that are designed to use less electricity for the same capabilities. Energy efficiency does not require any changes in the services expected. On the other hand, energy conservation is defined as reducing the energy consumed through a reduction in services. Examples of energy conservation would include lowering thermostat settings in the winter or limiting television use.

Electricity is generated from a variety of sources: coal, natural gas, petroleum, nuclear, hydropower, biomass, and wind. The conversion of these fuel sources into electricity consumes a considerable proportion of the potential usable energy. In 2006, 41.27 quadrillion British thermal units (Btu) of energy from these sources was consumed to produce electricity (EIA 2007). Of this total, conversion losses consumed 26.71 quadrillion Btu, or 65% of the total energy. One opportunity for energy efficiency is to reduce these conversion losses through improved technologies or repowering. Repowering basically means adding a gas turbine with a heat recovery system to older (1970s and earlier) steam boiler generating units to create a combined cycle. Combined-cycle plants (sometimes also called cogeneration plants) do two things: they add generating capacity and make gas (or liquid) burning more efficient. Combined-cycle plants can realize efficiencies of 60–85%, whereas the existing steam boiler plants have generating efficiencies around 35%. Repowering uses existing footprint/infrastructure, has lower air emissions, and is cost-competitive with simple-cycle new builds (i.e., gas turbines without a steam boiler component that does not capture exhaust) and renewables.

Getting electricity to the user consumes a significant amount of energy. In 2006, the United States consumed approximately 3,820 billion kilowatt hours (kWh) of electricity (EIA 2007). The residential sector consumed the most with 1,354 billion kWh, while the industrial sector consumed 1,301 billion kWh, and the commercial sector consumed 1,022 billion kWh. An estimated 9% of the gross generation was consumed by transmission and distribution losses.

Improving energy efficiency consumption can be accomplished by a variety of measures. In the commercial sector, buildings can be made more efficient by improving insulation, using double-paned windows, and other methods for reducing heating and cooling requirements. The industrial sector can improve energy efficiency by upgrading and maintaining equipment. The residential sector can improve energy efficiency by using insulation and weather stripping to reduce heating and cooling losses, by using efficient appliances and other electrical equipment, and by using efficient lighting. The USDOE Energy Efficiency and Renewable Energy Web site describes in detail many energy efficiency improvements (www.eere.energy.gov). While there are many Federal, State, local, and even company programs to encourage more energy-efficient production and consumption—such as tax credits for the purchase of energy efficient automobiles—in the United States, most energy efficiencies are market driven. For example, a company can increase profits if it can more efficiently convert oil into electricity and people can reduce energy expenses by improving home insulation.

Conservation methods require the changing of use patterns, such as setting the thermostat higher during summer or using only needed electric light. Conservation may also include turning off appliances, such as computers, when they are not in use or using mechanical rather than electric appliances (e.g., a hand-operated rather than an electric can opener). While many people practice energy conservation out of a sense of duty or principle, in the United States, energy conservation is generally driven by price—as the price of gasoline increases, for example, people tend to drive less.

Evaluating how much energy can be saved through energy efficiency and conservation is difficult. The EIA began a program to quantify energy efficiency in the U.S. economy after passage of the Energy Policy Act of 1992. The effort is discussed in the report *Measuring Energy Efficiency in the United States' Economy: A Beginning* (EIA 1995). As yet, there is no clear way to compare methods of energy efficiency with energy production. Because most energy efficiency and conservation is driven by market forces, there is also no clear method to compare efficiency conservation with a specific energy proposal.

7.5.6 Cost-Benefit Analysis

In response to scoping comments, the MMS prepared a cost-benefit analysis for the renewable energy resources analyzed in this EIS (Weiss et al. 2007). The analysis provides information concerning potential benefits and costs (in a social welfare context) from energy development activities on the OCS. The scope of the work comprised three phases. In the first phase, the electric power market into which offshore energy projects would sell electricity and the state of technological development for offshore wind, wave, and ocean current energy projects were considered. Representative "project profiles" for each technology were developed, focusing on the characteristics that would influence the type and magnitude of potential social and environmental benefits and costs.

In the second phase, the categories of benefits and costs that might be applicable to an analysis of offshore energy projects (i.e., the benefits and costs of onshore generation alternatives as well as those associated with offshore energy alternatives) were addressed. Since the intent was to consider benefits and costs from a social welfare perspective, the focus is on categories of impact that can be considered market "externalities" (i.e., those factors, such as ecological impacts of project construction, that are not incorporated into the market price of electricity). In an effort to capture the full range of potential benefits and costs, categories of impact that could occur at each stage of a generation facility's life cycle (construction, fuel acquisition and transportation, operation and maintenance, and decommissioning) were considered. The identified benefits and costs were then categorized based on whether they can be quantified and monetized using existing, readily available data.

The third phase examined not only the relationship between the benefits and costs of offshore energy projects but also the key data and analytic gaps that future research might address. Specifically, the benefits and costs of the three representative offshore energy project types were analyzed relative to the onshore generation that these projects might "displace." Because the degree of actual displacement of onshore generation by an offshore project would be dictated by a complex interrelationship of many factors, two simplified "scenarios" were examined:

- Offshore energy displaces coal-fired generation, under the presumption that this will provide an indication of the maximum difference in externalities between onshore and offshore generation;

- Offshore energy displaces a fuel mix that is proportional to the anticipated generation mix in the market region into which the offshore projects would supply electricity.

While the available information limits the ability to perform a detailed cost-benefit analysis, the potential social benefit from offshore renewable energy projects is the displacement of air emissions that might otherwise be generated by onshore electrical generation facilities.

7.6 CUMULATIVE IMPACTS

Cumulative impacts are the impacts on the environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency, industry, or person undertakes the other actions. For purposes of this programmatic EIS, reasonably foreseeable future actions are those actions for which an application or request for a permit has been submitted to a Federal, State, or local agency.

Other OCS activities considered in this assessment include existing and future oil and gas development activities, construction and operation of LNG facilities, marine transport, commercial and recreational fishing, other recreational activities, dredging for sand and gravel, construction of artificial reefs, and military use. Activities occurring in State waters include proposed alternative energy projects as well as many of the activities also occurring on the OCS. These activities have impacting factors similar to those considered for alternative energy facilities. Global climate change also affects the geophysical environment of the OCS and coastal areas. The cumulative analyses include a qualitative evaluation of the potential impacts from all of these activities and processes occurring presently and in the foreseeable future, and the addition of the proposed action. The analysis also considers the potential for multiple alternative energy facilities on the OCS.

The programmatic EIS evaluates potential activities that may be initiated in the next 5 to 7 years. Should a commercial activity be initiated in this time frame, it is expected that operations will continue for at least 20 years, therefore, the time frame for this cumulative analysis is 20 to 40 years to encompass project activities ranging from site characterization through decommissioning. As stated in Section 1.3.2, the geographic limits of this analysis include the Federal waters extending from the State/Federal boundary out to the 100-m (300-ft) depth contour for wind and wave activities and to the 500-m (1,600-ft) depth contour for marine currents. Alaska and Hawaii are not considered for reasons discussed in Section 1.3.

7.6.1 Past, Present, and Proposed Actions and Processes Impacting the OCS

The proposed action is described in Chapters 1 and 2, and the impacts are discussed in Chapters 5 and 6 and in Section 7.1. Other potential activities and processes that could result in cumulative impacts with the activities to be conducted under the proposed action are described below. These activities include those that would occur on the OCS as well as certain activities that would take place in State waters and on land.

7.6.1.1 Alternative Energy Development Projects

The Alternative Energy and Alternate Use Program is in the process of being developed. However, applications for preliminary permits to undertake marine current projects have been submitted to another agency. Moreover, Section 388 of EPAct allows for the continuation of the process for two applications that had previously been submitted to the U.S. Army Corps of Engineers (USACE). In addition, the State of Delaware has approved one offshore wind project for development, and the project developer is currently negotiating the terms of a power purchase agreement with the state utility. Several proposals have been made for pilot- and commercial-scale alternative energy facilities (Table 7.6.1-1) on the OCS and in State waters. Although it is unknown whether these projects will be approved and what they will entail, they are used in this EIS as an indicator of potential alternative energy development in this cumulative impacts analysis.

TABLE 7.6.1-1 Proposals and Applications for Alternative Energy Projects on the OCS or in State Waters

Project	Location	Proposed Power and Size of Facility	Technology	Notes and References
Long Island Power Authority	5.8 km (3.6 mi) south of Jones Beach Island, area of 21 km^2 (8 mi^2), North Atlantic region	40 turbines, 3.6-MW/turbine (total = 144 MW)	Wind	USDOI/MMS 2006k
Cape Wind	7.6 km (4.7 mi) offshore Cape Cod, MA, area of 62 km^2 (24 mi^2), North Atlantic region	130 turbines, 3.6-MW/turbine (total = 468 MW)	Wind	USDOI/MMS 2006l
Galveston Offshore Wind, LCC	11 km (7 mi) offshore of Galveston, TX	Total of 150 MW	Wind	Texas General Land Office 2005
Bluewater Wind	10 km (6 mi) offshore of Delaware coast	600 MW	Wind	www.bluewaterwind.com
Plum Island	0.45 km (0.28 mi) from the south shore of Plum Island, NY	3 turbines 3.6-MW/turbine 10.8 MW	Wind	www.winergyllc.com
Makah Bay Demonstration Plant	6 km (3.7 mi) offshore of Washington State; depth of 46 m (150 ft), Washington/ Oregon region	4 WECs, 250-kW/WEC (total = 1 MW)	Wave (AquabuOY)	AquaEnergy Group Ltd. 2006
Reedsport Wave (Ocean Power Technologies)	3.2 km (2 mi) offshore at Reedsport, OR, area of ~0.61 km^2 (0.24 mi^2)[a]; 50-m (164-ft) depth, Washington/Oregon region	200 WECs, 250-kW/WEC (total = 50 MW)	Wave (PowerBuoy®)	OPT 2006b
Coos Bay OPT Wave Facility Project	4 km (2.5 mi) offshore near Coos County, OR	200–400 buoys, 100 MW	Wave (PowerBuoy)	OPT 2007
Coos County Wave Energy Power Plant	3–5 km (2–3 mi) offshore Coos County, OR	200–300 devices, 100 MW	Wave	Finavera 2007
Newport OPT Wave Facility Project	5–10 km (3–6 mi) off Lincoln County, OR	200–400 buoys, 100 MW	Wave (PowerBuoy)	OPT 2007

TABLE 7.6.1-1 (Cont.)

Project	Location	Proposed Power and Size of Facility	Technology	Notes and References
Florence Wave Facility Project	2–5 km (1–2.9 mi) off Florence, Lane County, OR	10 wave devices, 10 MW	Wave	FERC 2007a
Lincoln County Wave Energy Project	0–5 km (0–3 mi) offshore of Lincoln County, OR	9 proposed projects, 20–180 MW	Wave	FERC 2007a
Douglas County Wave and Tidal Energy Project	Mouth of Umpqua River in Douglas County, OR	1–3 wave units, 1–3 MW	Wave	FERC 2007a
Humboldt County Offshore Wave Energy Project	3–5 km (2–3 mi) offshore of Humboldt County, CA	200–300 buoys 200 kW to 1 MW each	Wave (AquaEnergy)	FERC 2007a
Fairhaven OPT Wave Power Project	5 km (2.8 mi) offshore of Humboldt County, CA	40–80 Powerbuoys, 20 MW	Wave (OPT PowerBuoy)	FERC 2007a
PG&E Mendocino WaveConnect Project	Off the coast of Mendocino County, CA	40–200 wave generators, 40 MW	Wave	FERC 2007a
PG&E Humboldt WaveConnect Project	Off the coast of Humboldt County, CA	8–200 buoys, 200 kW to 1 MW each	Wave	FERC 2007a
Mendocino Wave Energy Project	Off the coast of Mendocino County, CA	2–60 devices, 2–60 MW	Wave	FERC 2007a
Sea Gen Projects	7 projects, variable distances off the coast of Florida	20–40 turbines, 20–40 MW for each facility	Ocean current	FERC 2007a
Florida Hydro, Inc.	~5 km (3 mi) offshore near Palm Beach County, FL	8 turbines, 2–3 MW total	Ocean Current	FERC 2007a

[a] OPT Web site states 30 acres/10 MW; 10 MW = 40 WECs; therefore, proposed facility will be 5 times as large (150 acres * 10,000 m^2/2.47 acres * 0.61 km^2 * 1 mi/2.59 km^2 = 0.24 mi^2).

A summary of applications and proposals for alternative energy projects on the OCS or in State waters is provided in Table 7.6.1-1. The summary is not exhaustive, as the MMS and the States may receive new project proposals. As of July 2007, there are five proposed offshore wind energy projects totaling about 1,400 MW of power, eight proposed wave energy projects off the coast of Washington State and Oregon totaling about 540 MW, five proposed wave energy projects off the coast of northern California totaling about 102 to 620 MW, and eight proposed ocean current projects off the coast of Florida with a capacity of 142 to 283 MW. The Long Island Power Authority and Cape Wind projects in the North Atlantic region are currently undergoing NEPA reviews.

Technology development is such that alternative energy facilities would most likely be sited at depths of less than 100 m (300 ft). The most economically viable depth for wind turbine generators (WTGs) is 5–20 m (16–64 ft), and the depth requirements for WEC technologies range from 20–90 m (66–300 ft). However, the requirements for ocean current technologies range from about 18 m to more than 500 m (60 to 1,600 ft); see Section 3.1. These depth limitations mean that, in the near term, OCS alternative energy development is likely to occur within 100 nautical mi (190 km, 115 mi) from shore in the Atlantic region, within 130 nautical mi (240 km, 150 mi) from shore in the Gulf of Mexico (GOM) region, and within 30 nautical mi (56 km, 35 mi) from shore in the Pacific region. (An exception occurs in a small area in the North Atlantic planning area that has depths of less than 100 m [300 ft] out to a distance of about 150 nautical mi [270 km, 170 mi]). Although these depth limitations for alternative energy technologies substantially limit the area in which facilities are likely to be located, they nonetheless allow for substantial distances between facilities.

The currently proposed wind facilities are quite distant from one another (separated by more than 160 km (100 mi) off the coasts of Massachusetts, New York, Delaware, and Texas), whereas the proposed wave facilities on the OCS off the coasts of Oregon and northern California are somewhat closer to one another.

A quantitative scenario projecting the level and location of development is not included in the programmatic EIS. An estimation of the level of activity generated by the establishment of this program would be speculative at this time, particularly because scenarios are generally developed from historic information, which does not exist for this undertaking. Therefore, the discussions concerning the cumulative impacts from activities that may result from the program are discussed qualitatively. The MMS will prepare NEPA documents for lease sales and site-specific projects tiered off of this programmatic EIS; these analyses will focus in more detail on the key issues of a smaller geographic area. Additionally, if numerous facilities are proposed in a specific relatively small geographic location, more data will be available to carefully analyze issues such as multiple-use conflicts with navigation, fisheries, recreation, and military uses; interference with migratory pathways; and visual impacts from multiple sites.

7.6.1.2 Oil and Gas Activities

7.6.1.2.1 Atlantic. The Atlantic region does not currently have active oil and gas leases or platforms, although historically there have been 433 leased blocks, and exploratory wells were drilled (USDOI/MMS 2006a). At this time, one new lease sale has been proposed for the Atlantic region (USDOI/MMS 2007a). The area under consideration is still subject to a moratorium, which would need to be lifted before a lease sale could occur. Should a lease sale be held and leases issued, only low-level oil and gas activity, mainly seismic survey activities and the drilling of exploratory wells in the near term, is expected. Environmental impacts from these potential activities are discussed in the *Proposed Final Program, Outer Continental Shelf Oil and Gas Leasing Program: 2007–2012* (USDOI/MMS 2007b).

7.6.1.2.2 Gulf of Mexico. Offshore production in the GOM averaged 1.3 million barrels/day (bbl/d) of oil and 7.9 million cubic feet/day (ft^3/d) of gas in 2006. There are approximately 3,900 operating oil and gas-related structures (includes platforms, wellheads, and caissons) in the GOM region. Exploration and production of oil and gas in State-regulated coastal waters is ongoing, particularly in Alabama, Louisiana, and Texas (about 100 rigs operating in Louisiana, 10 rigs in Texas, and 2 producing fields in Alabama's Mobile bay). No notable quantities of oil and gas have been found in State-regulated Mississippi waters, and Florida has a moratorium on drilling in State waters.

The extent of cumulative projected development of oil and gas facilities in the GOM over the next 40 years is provided in Table 7.6.1-2. Development is expected to increase over the planning period, and the total projected seafloor area to be disturbed by platforms and pipelines would be 17,000 ha (42,000 acres), about 0.1% of the entire OCS leased area of 17 million ha (42 million acres) in the GOM. Projected numbers and volumes of oil spills for the GOM region over a period of about 40 years are included in Table 7.6.1-2.

The central and western portions of the GOM have extensive onshore infrastructure (including gas processing plants, navigation channels, oil refineries, pipelines and pipeline landfalls, platform fabrication yards, and waste management facilities) to support oil and gas processing and transport, but there are no such facilities in the eastern planning area (USDOI/MMS 2007a). Existing ports and fabrication facilities could potentially be used during construction of alternative energy facilities.

There is one deepwater port in the GOM, which is a facility to provide for offshore offloading of oil from tankers too large for conventional ports, and to transport the oil to shore through a pipeline. The Louisiana Offshore Oil Port (LOOP) is located about 30 km (19 mi) offshore; access to this facility is through a designated fairway and safety zone within which no mobile drilling operations or installation of permanent structures may take place. In 2005, this facility handled about 1.2 million bbl/d of imported oil, which is about 14% of U.S.-imported waterborne crude oil. The LOOP also handles about 300,000 bbl/d of domestic offshore crude oil (USDOI/MMS 2007c).

TABLE 7.6.1-2 Projected Cumulative Oil and Gas Activities in the Gulf of Mexico[a]

Activity	Values for Gulf of Mexico
New production structures installed (total)	3,000–3,300
New exploration and delineation wells (total)	7,300–9,400
Development and production wells	31,000–36,000
Total length of installed pipeline (km [mi])	9,500–67,000 [5,900–42,000]
Service vessel trips (×1,000)	6,700–8,600
Helicopter trips (×1,000)	38,000–60,000
Drill muds/well (barrels [bbl])[b]	
Exploration/delineation	7,860
Development/production	5,800
Drill cuttings/well (bbl)[b]	
Exploration/delineation	2,680
Development/production	1,630
Produced water/well (bbl)[b]	
Exploration/delineation	450
Development/production	68
Total bottom area disturbed (hectares [acres])[b]	
Platforms	3,000–5,000 [7,400–12,000]
Pipeline	9,000–12,000 [22,000–30,000]
Production structures removed using explosives	4,200–4,300
Production structures removed (total)	6,000–6,100
Projected oil spills in GOM over 40 years[b]	
Large spills (>1,000 bbl)	
Pipeline (4,600 bbl)	5
Platform (1,500 bbl)	30
Tanker (5,300 bbl)	10
Small spills	
50–999 bbl	200
<50 bbl	2,500
Projected oil spills from import tankers[b]	42

[a] Source: USDOI/MMS (2007c), Tables 4-4, except where noted. Values applicable for a time period of 40 years; 2007–2046. Values in the table are rounded to two significant figures.

[b] Source: USDOI/MMS (2007b), Tables IV-14 and IV-17.

There is a large volume of crude oil transport through the GOM. To decrease the probability of collisions with stationary platforms and with exploratory drilling rigs, a series of safety fairways and anchorages has been established to provide an unobstructed approach for vessels, particularly large vessels, using U.S. ports.

7.6.1.2.3 Pacific. There are currently 10 State and 23 Federal OCS offshore oil and gas facilities from northern Santa Barbara County to Huntington Beach. The majority of the OCS platforms (19) are located off the coast of Santa Barbara County and Ventura County. A total of

38 fields have been discovered on the California OCS, including 14 fields in the offshore Santa Maria Basin, 22 fields in the Santa Barbara Channel, and two fields in the offshore Los Angeles Basin.

Offshore oil production peaked in State waters in 1969 and in Federal waters in 1996. As of 2003, daily production from the 43 developed Pacific OCS leases offshore California was 81,470 bbl/d of oil and 160,026 million ft^3/d of gas. This production is attributed to 13 fields. Remaining reserves for these fields were estimated to be 303 million bbl of oil and 987 billion ft^3 (bcf) of gas (as of December 2003). At January 2004 production rates, these reserves will last about 10 to 18 years for oil and 19 years for gas. Cumulative regional production as of December 2003 was 1,085 million bbl of oil and 1,377 bcf of gas.

In Pacific ports, refined petroleum is the primary oil product received on incoming tankers. In 1999, 39 million metric tons (MT) of imported and domestic refined petroleum was received, in comparison with 5 million MT of crude oil (USDOI/MMS 2002b). Eighty percent of this was received at the California ports.

7.6.1.3 Other Offshore Activities

This section discusses activities occurring on the OCS not presented in other sections of this EIS including offshore disposal, point- and non-point-source effluents, LNG, sand and gravel dredging, and other activities. There are also common activities such as transportation, commercial fishing, and recreational uses (fishing, boating, swimming, and surfing) that occur in State waters and along coastlines that may add to cumulative impacts. The nature and extent of cumulative impacts resulting from these activities would be highly site dependent and would be addressed as part of the environmental reviews conducted for individual projects in the future.

7.6.1.3.1 Offshore Disposal. Virtually all material ocean-dumped in the United States today is dredged material (sediments) removed from the bottom of water bodies in order to maintain navigation channels and berthing areas. Other materials that are currently ocean-dumped include fish wastes, and vessels. Certain materials, such as high-level radioactive waste, medical waste, sewage sludge, and industrial waste, may not be dumped in the ocean. Ocean dumping of dredged material is regulated under Title I of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), as amended (33 USC 1401 et seq.). Most dumping of dredged material takes place at ocean dumping sites specifically designated by the USEPA for dredged material disposal under Section 102 of the MPRSA. The USACE is required to use such sites for ocean disposal. The USEPA's ocean dumping regulations at 40 CFR Part 228 provide the criteria and procedures for the designation and management of ocean disposal sites and list the currently designated sites by USEPA region. There are 36 dredged material disposal sites designated in the Atlantic region, 28 in the GOM region, and 22 in the Pacific region.

7.6.1.3.2 Point- and Non-Point Source Effluents. Point sources of discharged waste into both near-shore and coastal waters include sewage treatment facilities, industrial facilities, and electric generating facilities. These effluents may contain synthetic organic chemicals, heavy metals, oxygen-consuming materials, and potentially pathogenic microorganisms, or may be elevated in temperature. Facilities with point-source discharge are located throughout the Atlantic, GOM, and Pacific coastal regions; the largest discharges occur from the major metropolitan areas.

Major non-point sources of effluents to ocean waters include runoff and marine transportation vessels. Runoff can contain a large variety of pollutants such as those listed for point sources. Releases from marine vessels are generally petroleum hydrocarbons but could also include accidental release of sanitary wastes. Routine discharges from marine transportation vessels are regulated by the U.S. Coast Guard.

7.6.1.3.3 Sand and Gravel Excavation. Sand and gravel excavation on the OCS occurs in all three regions managed by the MMS. Increased use of sand borrow sites in State waters has lead to a depletion in this resource and the use of sand and gravel from locations farther offshore in Federal waters. Between 1995 and 2006, the MMS provided more than 21 million m^3 (27 million yd^3) of OCS sand for 18 coastal projects. These projects restored more than 150 km (93 mi) of the nation's coastline, protecting critical military installations, national parkland, wildlife refuges, and billions of dollars of infrastructure. Borrow sites are identified on an as-needed basis, and State and local communities work through the USACE to acquire the necessary permits for dredging.

7.6.1.3.4 Liquefied Natural Gas Facilities. Natural gas is liquefied to concentrate a much greater volume of product in a given space to facilitate storage and/or transportation. Use of LNG reduces the volume that natural gas occupies more than 600 times, making the transportation of gas in tankers economical. With an expected doubling of the amount of imported natural gas in the United States during the next 20 years, it is reasonable to anticipate more LNG facility construction in the United States (USDOE 2003).

Currently in the GOM, more than 20 of these facilities are at the planning or permitting stages, with three on the OCS. One, the Gulf Gateway facility, began operation 214 km (116 mi) off the coast of Louisiana in 2005. These facilities will offload vaporized LNG from tankers into the existing offshore natural gas pipeline system. Thirteen facilities along the Atlantic Coast and 7 facilities along the Pacific Coast are in the planning or proposed stages (FERC 2007b). Although the MMS does not permit or regulate these facilities, their increased presence and use on the OCS will create space-use issues and will add to the existing mix of potential offshore cumulative impacts.

Environmental effects specific to LNG transportation and facilities are associated with explosions and fires and with the cryogenic and cooling effects of either an accidental release of LNG or the release of cooled water during the vaporization process. Some facilities have proposed the use of an open-loop vaporization process to gasify the LNG. This process uses a large amount of ambient water (492 million–946 million L/d [130 million–250 million gal/d]) and results in a discharge that is cooler than the surrounding water by as much as –6.7°C (20°F).

In addition, biocides such as copper and sodium hypochlorite are added to the water. Intake of the large volume raises concerns about entrainment and entrapment of ichthyoplankton. Because of these concerns, many proposals are being re-evaluated and proposing the use of a closed-loop system.

7.6.1.3.5 Artificial Reefs. Artificial reefs are composed of solid man-made material that is deposited in the marine environment to provide hard substrate. The hard substrate provides a place for attachment of many types of marine life such as barnacles, sponges, corals, and marine algae. Over time, these artificial reefs develop complex ecosystems. The man-made materials for these reefs can include ships that were either accidentally or intentionally sunken, concrete blocks, tires, offshore oil platform jackets, airplanes, and various other materials that have been deposited in the ocean. Many coastal states have artificial reef programs to administer these reefs, which include creating new reefs, providing maps of their locations, and requiring buoys to mark them. Recreational fishermen and divers visit these reefs to enjoy the fish or explore the habitat.

7.6.1.4 Global Climate Change

The temperature of the earth's atmosphere is regulated by a balance between the radiation received from the sun, the amount reflected by the earth's surface and clouds, and the amount of radiation absorbed by the earth and atmosphere. The so-called greenhouse gases, which include CO_2 and water vapor, keep the earth's surface warmer than it would be otherwise because they absorb infrared radiation from the earth and, in turn, radiate this energy back down to the surface. While these gases occur naturally in the atmosphere, there has been a rapid increase in concentrations of greenhouse gases in the earth's atmosphere from anthropogenic sources since the start of industrialization, which has caused concerns over potential changes in the global climate. The primary anthropogenic greenhouse gases are CO_2, CH_4, nitrous oxide (N_2O), and halocarbons (carbon compounds that contain fluorine, chlorine, bromine, or iodine).

The atmospheric concentration of CO_2 has increased from a pre-industrial value of about 280 parts per million (ppm) to 379 ppm in 2005, which is an increase of about 35% (Intergovernmental Panel on Climate Change [IPCC] 2007a). Atmospheric CH_4 concentrations have increased from a pre-industrial value of about 715 parts per billion (ppb) to 1774 ppb in 2005, and concentrations of N_2O have risen from about 270 ppb in the pre-industrial age to 319 ppb in 2005 (IPCC 2007a). Global concentrations of halocarbons have generally peaked as a result of the implementation of regulations under the Montreal Protocol.

The global averaged surface temperature in the 1906–2005 time period has increased by 0.74 ± 0.18°C (1.3 ± 0.32°F) (IPCC 2007a). Eleven of the last 12 years (1995–2006) rank among the 12 warmest years globally since about 1850. The largest increases in temperature have occurred over the mid- and high latitudes of the Northern Hemisphere. Annual precipitation has increased in many areas in the middle and high latitudes of the Northern Hemisphere, while drying has been observed in portions of the subtropics (IPCC 2007a). It also appears that there has been an increase in the frequency of heavy precipitation events in the mid- and high latitudes of the Northern Hemisphere. Observations show a decrease in snow cover and land-ice extent. The annual average Arctic sea-ice extent has shrunk by about 2.7% per decade since 1978, with decreases of 7.4% per decade in the summer (IPCC 2007a).

A number of different naturally occurring climate forcing agents can affect the global climate, including changes in solar radiation, volcanic eruptions, and feedbacks from the ocean. The IPCC examined each of these factors over large time scales and determined that natural variability could not account for all of the warming observed in the 20th century. The IPCC in its Fourth Assessment Report published in 2007 concluded that: “Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.” The IPCC defines the term “very likely” as meaning a probability of occurrence of greater than 90%.

Projections of greenhouse gas emissions for the 21st century have been made using a number of emission scenarios reflecting different assumptions about economic growth, population, and technological emphasis (IPCC 2007a). The various projections provide a large range in projected emissions of greenhouse gases. The climate system response to increases in greenhouse gases is investigated by the use of computer models of the earth’s climate system, known as atmosphere-ocean global climate models. The ability of the models to predict future climate is limited by their relatively coarse resolution (about 250 km [150 mi] in the horizontal for the atmospheric component). The effects on a finer scale, such as those caused by clouds, cannot be modeled directly but have to be approximated on a grosser scale. Furthermore, clouds introduce significant uncertainties because they can result in either warming or cooling, depending upon cloud height, thickness, and other properties. The effects of sulphate aerosols are also difficult to quantify.

On the basis of model simulations applied to six different greenhouse gas emission scenarios, the IPCC projected an increase of the globally averaged surface temperature of 1.8–4.0°C (3.2–7.2°F) for the end of the 21st century relative to the 1980–1999 period (IPCC 2007a). There is a range of outcomes for each emissions scenario such that, for the lowest impact scenario, the likely range is 1.1–2.9°C (2.0–5.2°F), and for the highest impact scenario, the likely range is 2.4–6.4°C (4.3–11.5°F) (IPCC 2007a). The models showed that land areas would warm more rapidly than the global average, especially in the northern high latitudes in the cold season. Globally, average precipitation is predicted to increase, with some differences by region as well as season. There is also evidence that an increase in precipitation would correlate with greater variability from year to year. Additionally, it appears likely that the continental interiors would experience more frequent and intense summer droughts. The global mean sea level is projected to rise by 0.18 to 0.59 m (0.59 to 1.9 ft) due to thermal expansion and melting from glaciers and ice caps. These estimates do not include any future rapid dynamical changes in ice flow.

7.6.1.4.1 Potential Consequences of Global Climate Change. The IPCC has assessed the potential consequences of global climate change (IPCC 2007b). The report includes discussions on the sensitivity, adaptive capacity, and vulnerability of natural and human systems to climate change. According to the IPCC projections, crop yields in most tropical and subtropical regions would decrease, as would water availability for populations in water-scarce regions, particularly in the subtropics. The exposure to vector-borne and water-borne diseases would expand, and the risk of flooding due to higher incidences of heavy precipitation and sea-level rise would increase. If the global temperature increase were to rise by more than a few degrees Celsius, reduced crop yields would be likely in the mid-latitudes as well. There would also be some beneficial aspects to climate change. The increase in CO_2 levels may increase crop yields in the mid-latitudes if the increase in temperature stays relatively small. The global timber supply may increase from appropriately managed forests, and there would be a reduction in winter mortality from cold weather stress in the mid and high latitudes.

The developing countries would be more vulnerable to climate change because more of the economy is sensitive to climatic variations. Many areas are prone to destructive droughts and floods. Population and agricultural centers in the tropics are often located in low-lying coastal areas, which are vulnerable to sea-level rise. Nutrition is deficient, and the health infrastructure is relatively poor. There is less capacity to adapt because of limited technological, financial, and institutional resources.

The IPCC investigated various strategies for reducing greenhouse gas emissions (IPCC 2007c). Costs depend strongly on technological development and the timing and level of greenhouse gas stabilization. Lower emissions would require switching to lower-carbon fuels and increasing the energy efficiencies of buildings, transportation, energy production, and manufacturing. Appropriate management of forests, agricultural lands, and ecosystems could be used to sequester carbon. Progress is being made in the technological development of wind turbines, hybrid vehicles, and fuel cells. Some emission reductions, such as those resulting from increased energy efficiencies, could result in net cost savings. Other measures would have varying degrees of cost. The reduction in greenhouse gas emissions would have some other direct benefits, such as improved air quality. The use of emissions trading would likely reduce the cost of reaching emission reduction goals.

The National Assessment Synthesis Team (NAST 2000) has summarized the consequences of climate change for the various regions in the United States as well as by resource (i.e., water resources, agriculture, ecosystems, coastal resources, and human health). There are considerable uncertainties in the magnitude of any future climate change and even greater uncertainties about impacts in specific regions. In addition, climate change is one of a number of anthropogenic and natural impacting agents. Significant stresses on the environment will occur with or without climate change. However, climate change may exacerbate a variety of environmental problems.

Increasing acidification of the ocean is believed to be caused by increased atmospheric CO_2 levels. It is predicted that the pH of the oceans could fall by 0.5 pH units by 2100 (Raven et al. 2006). Although the impacts of this pH change in such a complex system are unknown, it is feared that many species of ocean biota would be unable to adapt to such a drastic change occurring over such a relatively short time period.

Significant increases or decreases of river runoff due to changes in precipitation amounts and patterns would affect salinity and water circulation. Increased runoff would likely deliver increased amounts of nutrients such as nitrogen and phosphorus to estuaries, while also increasing the stratification between warmer fresher and colder saltier water (Boesch et al. 2000). This would increase the potential for algal blooms that deplete the water of oxygen and increase stresses on seagrasses, fish, shellfish, and benthic communities. Decreased runoff could diminish flushing, decrease the size of estuarine nursery zones, and allow an increase in predators and pathogens (Boesch et al. 2000). More frequent or longer-lasting droughts and reduced freshwater inflows could increase the salinity in coastal ecosystems.

Many commercial fish populations are already subject to stresses, and global climate change may aggravate the impacts of ongoing and future commercial fishing and human use of the coastal zone. Projected changes in water temperatures, salinity, and currents can affect the growth, survival, reproduction, and spatial distribution of marine fish species and of the prey, competitors, and predators that influence the dynamics of these species (Watson et al. 1998). Changes in primary production levels in the ocean because of climate change may affect fish stock productivity.

Recreational fishing is a highly valued activity that could have losses in some regions because of climate-induced changes in fisheries. The net economic effect of changes in recreational fishing opportunities because of climate-induced changes in fisheries is dependent on whether projected gains in cool- and warm-water fisheries offset losses in cold-water fisheries. Projected changes in marine and freshwater temperatures, ocean currents, and freshwater flows are more likely to impact growth, survival, reproduction, and spatial distribution of these species than of other species.

The survival, health, migration, and distribution of marine mammals and sea turtles may be impacted by projected changes in climate through impacts on their food supply and breeding habitats. The decreased availability of necessary habitats and prey species that results from climate change would have the greatest impact on marine mammal and sea turtle populations that are already under endangered species status. Marine mammal calving and pupping grounds and sea turtle nesting beaches would be threatened by rising sea level (Watson et al. 1998).

Sea-level rise would result in increased erosion of shorelines and beaches, increased salinity of estuaries and freshwater aquifers, altered tidal ranges in rivers and bays, changes in sediment and nutrient transport, and increased coastal flooding during storms. Barrier islands would tend to be shifted shoreward or breached. Wetlands and their habitats would be shifted or suffer loss. Damage to homes and infrastructure from coastal flooding would have substantial economic impacts.

Many estuaries are already stressed as a result of water pollution and agricultural runoff. Warming of estuaries would affect species distribution. Sea-level rise would cause inundation of tidal wetlands, shoreline erosion, and loss of islands and other tidewater lands. The rise in water level could also result in intrusions of higher salinity in the estuaries and their tributaries. Possible consequences of this include changes in the ecosystem and increased potential for salinization of groundwater.

Poleward shifts in distribution of marine populations can be expected with increasing water temperatures. Species' temperature preferences and overall habitat requirements would determine the extent of potential distribution shifts. For some species, the habitat requirements related to spawning and nursery areas can limit adaptation, which could result in loss of populations. Temperature changes may also affect the food web dynamics of the ecosystem.

7.6.1.4.2 Alternative Energy Development and Greenhouse Gas Emissions. Alternative energy development would result in only very minor greenhouse gas emissions, mostly during the construction and decommissioning phases. These emissions would be from construction barges, transport vessels, and crew boats. Alternative energy development has the potential to provide significant benefits in terms of reducing greenhouse gas emissions from energy consumption. Alternative energy development could be used as part of a strategy to manage carbon emissions by providing energy with very low emissions. If such a strategy includes a cap-and-trade program, a carbon tax, or various incentives for cleaner technology, alternative energy could become more competitive and could provide a meaningful contribution to efforts to achieve national carbon emission reduction goals.

7.6.2 Cumulative Impacts of Alternative Energy Development and Alternate Use of Existing Oil and Gas Platforms on the OCS under the Proposed Action

Cumulative impacts result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. At this time, the precise locations of potential new alternative energy facilities are unknown. When such facilities are proposed, the cumulative impacts would be assessed in the environmental reviews for the specific projects in relation to all other proposed projects in close proximity. This section addresses potential cumulative impacts in a generic manner.

The locations of currently proposed alternative energy facilities were described in Section 7.6.1. The proposed wind energy facilities are in the north Atlantic and the GOM, the proposed wave facilities are in the north and central Pacific region, and the proposed ocean current facilities are off the coast of Florida. The potential cumulative impacts of such facilities are briefly discussed in the following sections, in order to consider concerns about multiple facilities that could be proposed and constructed at later dates.

Within the time frame of this programmatic EIS, structures used for alternate use would likely be the oil and gas structures currently operating in the Gulf of Mexico or off of southern California (Figures 6.1-1 to 6.1-3). Some of the types of alternate use activities that could occur at these facilities include alternative energy production, aquaculture, and research and monitoring. Impacts from these types of activities are discussed in Section 6.3. Other reasonably foreseeable activities occurring in these areas include oil and gas production as well as other marine activities, such as commercial fishing and marine transportation, as discussed in Section 7.6.1. The incremental impacts from this action of leaving the structures in place added to other past, present, and reasonably foreseeable future actions would include artificial reef effects, continuing vessel usage, and a potential for collision with vessels. Oil spills are not expected to occur directly from the potential alternate use activities, but could occur from a vessel collision. Any impacts from specific alternate uses would be considered during the evaluation of actual proposed projects.

The assessment of cumulative impacts to specific ocean resources in this section is based on consideration of the existing and projected status of the OCS and nearby coastal areas, as described in Chapter 4 and in Section 7.6.1; it also considers the impacts of the proposed action (i.e., the impacts of one or more alternative energy facilities on the OCS) as assessed in Chapter 5. In the following sections, the existing and projected status of the OCS and nearby coastal areas is discussed, and the additional impacts from alternative energy facilities are considered. If it is assumed that mitigation measures for adverse impacts from alternative energy facilities would be applied as described in Chapter 5, the level of adverse impacts from these projects would generally be less (e.g., moderate impacts would become minor impacts).

7.6.2.1 Ocean Surface and Sediments

The geology of the OCS is discussed in Sections 4.2.1, 4.3.1, and 4.4.1 for the Atlantic, GOM, and Pacific regions, respectively. Existing activities that have an impact on ocean sediments include dredging and ocean disposal, and sand and gravel excavation. These activities can have important but localized impacts on unique geologic features, erosion, and alteration of topography.

On the basis of the assessments in Sections 5.2.1, 5.3.1, and 5.4.1, alternative energy facilities would have negligible to minor impacts on unique geologic features, acceleration of erosion, and alteration of topography. Because facilities would be sited more than 2 km (1.2 mi) offshore, impacts to sediment transport in areas where loss of beach sand is a concern should be negligible. Siting facilities parallel to the direction of wave travel (particularly for wave energy facilities) also decreases the impacts to sediment transport. The potential for a proposed alternative energy facility to interfere with sand and gravel excavation and ocean disposal of dredged materials is location-specific; such cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.2 Meteorology and Air Quality

The existing meteorology and air quality of the OCS and nearby coastal areas is discussed in Sections 4.2.2, 4.3.2, and 4.4.2 for the Atlantic, GOM, and Pacific regions, respectively. Vessel traffic is probably the highest contributor to air emissions and emissions of greenhouse gases on and near the OCS. Activities that involve vessel traffic on the OCS and in coastal areas (e.g., cargo vessels, commercial and recreational fishing boats, and military vessels) all produce similar emissions from engine exhaust. Oil and gas production activities on the OCS require a particularly high amount of vessel traffic (see Table 7.6.1-2). According to a recent EIS for the GOM, maximum allowable Prevention of Significant Deterioration (PSD) increments for 24-h SO_2 and annual nitrogen dioxide (NO_2) may be exceeded due to oil and gas production activities on the OCS over the next 40 years (USDOI/MMS 2007c).

Air quality impacts from alternative energy facilities, as discussed in Sections 5.2.2, 5.3.2, and 5.4.2, would primarily occur during construction. OCS alternative energy facilities could have short-term adverse air quality impacts from construction of new onshore electricity distribution facilities (specifically, there could be short-term exceedances of air quality standards for particulates at the site perimeter). The probability that onshore construction will be required is higher if the new facilities will bring power to an area with a small population, or if the facilities are producing larger amounts of electricity. Some vessels used during construction may use high-sulfur bunker fuels which could result in making PSD requirements applicable to the project. Such emissions would require mitigation so that the significance levels were not exceeded. Construction vessel emissions could also contribute to an exceedance episode in an ozone nonattainment area under certain conditions (e.g., see Section 5.2.2.3 for wind power). Air impact analyses and mitigation measures will be developed for specific projects as appropriate to protect Class I areas and avoid contributions to ozone exceedance episodes.

Cumulative impacts from the construction of multiple projects simultaneously are not anticipated because it is unlikely that two or more projects would be built in close proximity and at the same time. However, onshore impacts could be cumulative with other onshore construction activities. Such cumulative impacts are site-specific and would require evaluation in future NEPA work for specific projects.

Alternative energy facilities do not emit criteria air pollutants during operations, although gasoline and/or diesel-powered service vessels do emit these pollutants as well as volatile organic compounds. The projected number of service vessel trips for wind, wave, and current facilities is minimal (e.g., for wind facilities, at least one trip per day per facility). Many existing activities on the OCS and in nearby coastal areas impact air quality and greenhouse gas emissions. One or more alternative energy facilities would add a small amount to these impacts. A positive air quality impact would be associated with OCS alternative energy facilities if these facilities offset some use of fossil fuels. Cumulative air quality impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.3 Ocean Currents and Movement

Ocean currents, waves, and tides are discussed in Sections 4.2.3, 4.3.3, and 4.4.3 for the Atlantic, GOM, and Pacific regions, respectively. Other activities occurring on the OCS and in nearby coastal areas do not generally impact these processes, although use of greenhouse gas-generating fuels has an impact because global warming may impact ocean processes, especially currents.

The potential impacts of alternative energy facilities on ocean currents, waves, and tides are discussed in Sections 5.2.3, 5.3.3, and 5.4.3. Natural ocean currents and movement would be disrupted by both wave energy facilities and ocean current energy facilities; these effects would be minimal for wind energy facilities. According to one estimation (von Arx et al. 1974), the reduction of the energy of the marine current by 4% may lead to significant climate change impacts. While this represents a single estimation, evaluation of the cumulative impacts from the development of marine current facilities should be evaluated closely when additional information about the technologies and extraction ability is available.

If multiple wave or current energy facilities were located in close proximity to each other, the effects on ocean currents and waves could be additive. Potential project-specific and cumulative impacts to ocean currents and movements waves from multiple facilities would be carefully evaluated in separate environmental analyses for each newly proposed facility.

7.6.2.4 Water Quality

The existing water quality of the OCS and nearby coastal areas is discussed in Sections 4.2.4, 4.3.4, and 4.4.4 for the Atlantic, GOM, and Pacific regions, respectively. Activities and processes associated with adverse OCS water quality impacts include dredging and sediment disposal on or near OCS waters, municipal and industrial effluent outfalls into coastal waters, small spills of fuels or other chemicals from oil and gas platforms, and changes in salinity of estuaries due to global warming processes. Large oil spills could have a major adverse impact on water quality depending on the volume, location, and effectiveness of cleanup.

The potential impacts of alternative energy facilities on water quality are discussed in Sections 5.2.4, 5.3.4, and 5.4.4. The facilities are not anticipated to have operational discharges that will require a permit. Small spills of lubricants, solvents, etc., and resuspension of sediments would cause minor impacts to water quality during construction, operation, and decommissioning of alternative energy facilities. Discharges from vessels used in site characterization, construction, servicing, and decommissioning of alternative energy facilities would be regulated by the USCG. Depending on the proximity of facilities and the timing of activities, multiple facilities could have minor additive impacts on water quality.

Increased turbidity would be caused by drilling and installation of monopiles, platforms, and transmission cables for alternative energy facilities. Impacts would be worse if the resuspended sediment were contaminated. Construction, operation, and decommissioning of one or more alternative energy facilities would add to overall adverse water quality impacts from activities that result in sediment resuspension. The cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

Oil and gas development and production results in mostly small spills (see Table 7.6.1-1); any activity that involves use of fuel could result in spills. In comparison, the volume of spilled material from alternative energy facilities is expected to be very small because of the small volumes of hazardous materials needed for operation. Oil spills could occur from tankers transporting crude or refined oil products into ports in any of the three regions, or from existing oil platforms or pipelines. The probability of oil spills increases as the volume of small and large vessel traffic in each region increases, and as the number of permanent and mobile structures in State-regulated and OCS waters increases. New alternative energy facilities would increase the oil spill probability somewhat. However, the impact of additional vessel traffic associated with the alternative energy facilities would be negligible in comparison with already ongoing activities. Mitigation measures to decrease the probability of oil spills include requirements for the use of double-hulled tankers, lighting of all new structures on the OCS, and ongoing monitoring and updating of safe fairways and anchorages for vessels. Institutional controls to restrict vessel traffic in these areas would also be considered.

If an oil spill were to occur, the impacts would depend mainly on the size of the spill, the type of product spilled, the distance of the spill from coastal areas or islands, the weather conditions at the time of the spill, and the speed with which cleanup plans and equipment could be employed. Although the probability is low, if more than one large oil or chemical spill occurred within the same region and at about the same time (i.e., within months), cumulative impacts could occur, including shortages of cleanup equipment and staff. The best mitigation measures include oil spill contingency plans, the ability to quickly put those plans into action, and having sufficient equipment and trained staff available to clean up the spill.

7.6.2.5 Acoustic Environment

Shipping traffic is a leading contributor to ambient ocean noise, as discussed in Sections 4.2.5, 4.3.5, and 4.4.5. Other sources include other vessels (e.g., commercial and recreational fishing vessels), dredging, near-shore construction activities, oil and gas drilling, seismic surveys, and sonar signals (especially those used by the military). The increase in shipping traffic in recent decades is thought to be the main cause of a 2.5–3 dB increase in ambient noise levels per decade (see Section 4.2.5). Noise-generating activities from oil and gas activities in the GOM each year include construction of about 80 new production structures, drilling of 2,000 new wells, laying of up to 1,700 km (1,000 mi) of pipeline, and removal of 100 platforms using explosives (see Table 7.6.1-2).

The noise that would be generated from alternative energy facilities is discussed in Sections 5.2.5, 5.3.5, and 5.4.5. Site characterization, technology testing, construction and decommissioning of OCS alternative energy facilities could generate high-intensity noise (e.g., from pile driving or drilling, laying cable in bedrock, removal of pilings using explosives), which could cause minor to major impacts to marine biota depending on the species affected (e.g., avoidance behavior, hearing loss to mammals, some killing of fish present at close range [within 50 m (164 ft) of pilings]). Other construction-phase noise sources include ship and barge traffic and geophysical surveys. It is unlikely that construction-phase impacts would be cumulative for multiple alternative energy facilities, because for cumulative impacts to occur, these facilities would both have to be built in close proximity to each other and to be built at the same time.

Continuous noise would also be generated during operations at alternative energy facilities. Such noise could be additive for multiple alternative energy facilities in the same general area, although sound attenuation with distance would require that the facilities be relatively close together for noise impacts to be additive. Potential cumulative noise impacts from other projects occurring at the same time as and in close proximity to an alternative energy facility would need to be evaluated in greater detail in site-specific environmental impact analyses.

7.6.2.6 Hazardous Materials and Waste Management

Sources of hazardous materials and waste in the ocean are discussed in Sections 4.2.6, 4.3.6, and 4.4.6 and include vessels (e.g., large cruise vessels and military vessels), oil and gas development, and dredging. Allowable discharges are regulated under various State and Federal laws and the USCG. Accidental spills of petroleum products are most often associated with oil and gas development. For example, about 50 large oil spills and about 2,700 smaller spills associated with OCS oil and gas facilities are predicted over the next 40 years (Table 7.6.1-2).

Hazardous materials and waste management for alternative energy facilities are discussed in Sections 5.2.6, 5.3.6, and 5.4.6. Accidental spills of dielectric fluids, fuels, and lubricants from alternative energy facilities during testing, site characterization, construction, operation, and decommissioning could have minor to moderate impacts on ocean resources. The magnitude of the impacts would depend on the frequency, sizes, and locations of spills. Most spills would be small spills (i.e., around 7,571 L [2,000 gal] or less). The largest spill that theoretically could occur in association with a single alternative energy facility, based on current commercially available technologies, would be 151,417 L (40,000 gal) of dielectric fluid if the entire storage capacity from an ESP were released; such a release is highly unlikely. Since the volume of hazardous materials stored at any of type of alternative energy facility would be very small compared with the volumes transported on the OCS, spills from these facilities would contribute a minor amount to the impacts from spills from all activities on the OCS. Even multiple facilities closely spaced would not likely contribute significantly to the overall potential for hazardous material spills.

7.6.2.7 Electromagnetic Fields

The use of submarine power cables that generate EMFs is very limited in the United States; cables power some oil and gas platforms and some island communities (see Sections 4.2.7, 4.3.7, and 4.4.7). There is one cable in use that brings power from Connecticut to New York.

According to Sections 5.2.7, 5.3.7, and 5.4.7, EMFs in the vicinity of alternative energy facilities or associated submarine transmission cables would have negligible impacts on human health or aquatic species. The proposed cable systems for alternative energy facilities would be shielded to effectively block the electric field produced by the conductors. Since there are few other power cables on the ocean floor, cumulative EMF impacts from multiple facilities would be negligible (this conclusion also assumes that other cables in use would be required to have shielding, and considers that attenuation of EMFs occurs with increasing distance).

7.6.2.8 Marine Mammals

The types of marine mammals that are found on the OCS and in nearby coastal areas of the Atlantic, GOM, and Pacific are discussed in Sections 4.2.8, 4.3.8, and 4.4.8, respectively. There are many sources of adverse impacts to these marine mammals, including noise sources and vessel strikes associated with oil and gas development, commercial and recreational fishing, and cargo and military vessels. Marine mammals may also be adversely impacted by oil or hazardous material spills from any source. The Atlantic, GOM, and Pacific regions all host considerable numbers of commercial and recreational fishing vessels both in State-regulated and OCS waters that generate noise and may also strike marine mammals. The GOM has a high level of oil and gas development on the OCS that results in noise and vessel strikes and in spills that can adversely impact marine mammals. Additionally, global climate change appears to be altering habitats and food availability for many marine mammals (Learmonth et al. 2006).

The potential impacts of alternative energy facilities on marine mammals are discussed in Sections 5.2.8, 5.3.8, and 5.4.8. Alternative energy facilities could have minor to moderate or major impacts on marine mammals; the potential major impacts would be to threatened or endangered species whose populations are at critically low levels (e.g., North Atlantic right whales). Most of these impacts would be caused by injury or avoidance due to construction noise (e.g., from pile driving or drilling, laying cable in bedrock, removal of pilings using explosives), and by physical injuries from vessel or submerged turbine strikes. Mitigation measures could reduce the level of impacts. The impacts from construction noise would not be additive from multiple alternative energy facilities, because the construction of multiple facilities is unlikely to occur both in the same geographic area and at the same time.

There could also be moderate impacts from operational noise from alternative energy facilities, especially for mammals with feeding areas, mating areas, or migratory routes intersected by the facility. These impacts would be caused by the avoidance of the facilities and surrounding vicinity by marine mammals because of the noise, leading to abandonment of feeding or mating grounds and/or disruption of migratory routes. Marine mammals also may be adversely affected by the presence of underwater pilings or mooring devices that they could collide with or become entangled in. The presence of several alternative energy facilities that either were close to one another or intersected the same species migration routes could result in increased cumulative adverse impacts. Such cumulative impacts could include the inability to feed during migration, significant alteration of migratory routes, and increased probability of collisions or entanglement.

Oil spills from tankers or service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms) could cause toxicity or death for marine mammals coming in contact with the spilled materials. Spills associated with alternative energy facilities are less probable than spills associated with tanker transport of oil and those associated with oil and gas production, and would also likely be smaller in volume. Because good spill prevention practices would be in place for alternative energy facilities, the probability of several spills occurring at around the same time and from multiple alternative energy facilities is very low; such spills would contribute a minor amount to the impacts from spills from all activities on the OCS.

The cumulative impacts of all activities on the OCS on marine mammals include increased risk of mortality for individual marine mammals; the population-level impacts, however, depend on many factors (e.g., size and reproductive rates of affected stock, number, age, and size of animals affected) (USDOI/MMS 2007c). Alternative energy facilities are likely to contribute a minor proportion of the overall impacts to nonendangered marine mammals. However, for some endangered species, cumulative impacts could be major. For example, the most significant risks for the North Atlantic right whale are ship collisions and entanglement in fishing gear (Waring et al. 2007). Because this species has a high risk of extinction from these factors alone, current cumulative impacts to these mammals from all activities and processes are considered major. Additional adverse impacts from alternative energy facilities could be avoided or mitigated through proper siting and timing of activities.

7.6.2.9 Marine and Coastal Birds

The types of marine and coastal birds that could be impacted by activities on the OCS are discussed in Sections 4.2.9, 4.3.9, and 4.4.9. Collisions with structures are a major risk for marine and coastal birds. As stated in Section 5.2.9.4.1, it has been estimated that there are hundreds of millions of bird strikes into communication towers, windows, electric transmission lines, and other structures each year, while about 200,000 birds have been estimated to die each year from collisions with oil and gas platforms in the GOM alone. Spills of oil and other hazardous materials can also adversely impact marine and coastal birds coming in contact with the spilled materials.

The potential impacts of alternative energy facilities on marine and coastal birds are discussed in Sections 5.2.9, 5.3.9, and 5.4.9. For wind energy facilities, turbine collisions during operations may cause minor to moderate impacts for some species of marine, coastal, and terrestrial birds, depending on the species. There could be major impacts to threatened and endangered species with very low population levels. Additional wind facilities, particularly in the GOM where so many oil platforms are already located, and new wind facilities proposed in State waters (see Table 7.6.1-1), would affect cumulative impacts by increasing the potential for bird strike mortality over that already existing from platform collisions. The cumulative impacts may be minor to major, depending on the species involved and the number of individuals affected. A recent National Research Council study similarly concluded that cumulative impacts on bird fatalities from land-based wind energy facilities requires further study, especially because of projections of substantial increases in the numbers of wind turbines in the coming decades (National Research Council 2007). Lighting of the wind turbine structures could result in additional bird strikes, particularly for night-migrating species. However, mitigation measures are available to minimize bird strikes caused by lighting (see Section 5.2.9.6).

Whether bird strikes on WTGs would result in population-level impacts would depend on the numbers killed from a single species, whether an impacted species was endangered or otherwise specially designated, and on whether wind facilities were situated in migration pathways. Cumulative collision impacts to marine and coastal birds in the Atlantic area and the Pacific region would be less likely than impacts in the GOM because there are far fewer existing structures on the OCS in those areas, and plans for future development of oil and gas are more limited or nonexistent. The potential for significant cumulative impacts to marine and coastal birds from wind-facility turbine collisions would be evaluated in site-specific environmental impact analyses. Cumulative marine and coastal bird collision impacts are of minimal concern for wave and current technologies, because the associated structures generally do not protrude high above the ocean surface.

Construction in coastal areas can cause adverse impacts to coastal birds by interfering with nesting, decreasing food availability, etc. Onshore construction of cable landfalls or substations for alternative energy facilities may cause minor to moderate impacts to birds, primarily due to possible disruption of nesting areas. Offshore construction of alternative energy facilities may also cause negligible to moderate impacts, depending on the habitats and birds affected. Alternative energy facilities are likely to be a negligible to minor contributor to overall cumulative onshore impacts because there is only limited onshore construction anticipated, especially in the initial 5-to-7–year development period addressed in this programmatic EIS. Cumulative construction impacts from multiple alternative energy facilities are unlikely, because the facilities would generally not be constructed at the same time or very close together.

Oil spills from tankers or service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms) could cause toxicity or death for marine and coastal birds who contact the spilled materials or whose habitat becomes contaminated. Spills associated with alternative energy facilities are less probable than spills associated with tanker transport of oil and those associated with oil and gas production, and would also likely be smaller in volume. Such spills would contribute a minor amount to the impacts from spills from all activities on the OCS.

7.6.2.10 Terrestrial Biota

The types of terrestrial biota that could be impacted by activities on the OCS are discussed in Sections 4.2.10, 4.3.10, and 4.4.10. There are many potential sources of terrestrial biota disturbance onshore (e.g., commercial and residential developments, marine transport support facilities). Spills of oil or other hazardous materials can also impact coastal terrestrial biota. As discussed in Sections 5.2.10, 5.3.10, and 5.4.10, the construction and operation of onshore components of alternative energy facilities could cause negligible to moderate impacts to terrestrial biota. Potential onshore impacts would be from the disturbance of terrestrial wildlife during construction of transmission cable routes to electrical substations, and from substation operational noise and human activity. Alternative energy facilities are likely to be a negligible to minor contributor to overall cumulative onshore construction impacts because there is only limited onshore construction anticipated, especially in the initial 5- to 7-year development period addressed in this programmatic EIS. Cumulative construction impacts from multiple alternative energy facilities are unlikely, because the facilities would generally not be constructed at the same time or very close together.

Operation of completed onshore facilities could result in the long-term avoidance of adjacent habitats by species sensitive to noise and human activity. One mitigating factor is that OCS alternative energy facilities would likely tap into existing substations, so there would be no new noise source.

For wind facilities, impacts from turbine collisions to terrestrial birds and bats migrating over open waters would be similar to those for marine and coastal birds (see Section 7.6.2.9 for discussion of cumulative impacts). However, bat migration routes are not known to extend out to OCS regions where alternative energy facilities would be constructed (see Section 5.2.10.4), thus impacts to bats are expected to be low and noncumulative.

Oil spills from tankers or service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms) could cause toxicity or death for terrestrial biota coming in contact with the spilled materials. Spills associated with alternative energy facilities are less probable than spills associated with tanker transport of oil and those associated with oil and gas production, and would also likely be smaller in volume. Such spills would contribute a minor amount to the impacts from spills from all activities on the OCS.

Many existing activities on the OCS and in nearby coastal areas impact coastal biota. One or more alternative energy facilities would be expected to add minor additional impacts to these biota, primarily because the majority of the activities would be occurring more than 3 nautical mi (3.5 mi; 5.6 km) from shore. The cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.11 Fish Resources and Essential Fish Habitat

The existing status of fish resources and EFH is discussed in Sections 4.2.11, 4.3.11, and 4.4.11 for the Atlantic, GOM, and Pacific regions, respectively. The other activities that could have important impacts on OCS fish resources include commercial and recreational fishing and oil and gas development activities. Impacts from commercial and recreational fishing depend on the status of the species fished, fishing methods, and the magnitude of takings. Oil and gas activities on the OCS and in State-regulated waters require activities similar to those for alternative energy facilities with respect to impacts to fish resources (i.e., noise-generating activities, introduction of hard substrates, and disturbance of seafloor habitat). Spills of oil or other hazardous materials can also impact fish resources and habitat.

On the basis of the assessments in Sections 5.2.11, 5.3.11, and 5.4.11, alternative energy facilities could have negligible to moderate impacts on fish resources and EFH. These effects would mainly be from pile driving or drilling, laying of cable in bedrock, removal of structures with the use of explosives, and the presence of new habitat (i.e., hard substrate platforms) in ecosystems. Displacement, increased turbidity, and noise from pile driving or drilling and laying of cable in bedrock could result in mortality for low numbers of fish, but not in population-level impacts. Additionally, some wave and current technologies could adversely impact fish resources through entraining, impinging, or trapping fish and fish eggs.

The introduction of many hard-substrate structures in a given area of the OCS could alter the ecosystems, because species requiring hard substrate would likely move into the area, possibly displacing other species. This effect could be cumulative, increasing in proportion to the number of structures in an area. The cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

Oil spills from tankers or service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms) could cause toxicity or death for fish coming in contact with the spilled materials. Spills associated with alternative energy facilities are less probable than spills associated with tanker transport of oil and those associated with oil and gas production, and would also likely be smaller in volume. Such spills would contribute a minor amount to the impacts from spills from all activities on the OCS.

Many existing activities on the OCS and in nearby coastal areas impact fish resources and EFH. One or more alternative energy facilities would add to these impacts. The cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.12 Sea Turtles

The types of sea turtles that could be impacted by activities on the OCS are discussed in Sections 4.2.12, 4.3.12, and 4.4.12. The major cause of death for sea turtles in the United States and the GOM is capture and drowning in commercial fishing gear (National Research Council 1990). Activities that could damage the eggs and hatchlings of sea turtles onshore include construction, vehicle traffic, beach renourishment, and artificial lighting. Because of their long lifespan, exposures to chemicals in effluents or from small oil spills could cause toxicity in sea turtles because of long-term bioaccumulation.

As discussed in Sections 5.2.12, 5.3.12, and 5.4.12, alternative energy facilities would have minor to moderate impacts on sea turtles, depending on the locations and types of facilities. There is a possibility of major impacts if nests or aggregates of hatchlings are destroyed. Adverse impacts could be caused by noise (e.g., from pile driving or drilling, laying cable in bedrock, and/or removal of structures with explosives), vessel collisions with turtles, contact with solid debris, entrainment in overtopping wave energy devices, and onshore construction of cable landfalls and power substations. Mitigation measures would reduce the level of impact. Construction-related impacts are unlikely to be additive from multiple facilities because construction would not be expected to occur within close proximity and at the same time. However, impacts from construction of cable landfalls would be cumulative, increasing with the number of landfalls placed. The impacts are highly site-specific, depending on the locations of host turtle nesting grounds, and thus cumulative impacts would require evaluation in site-specific environmental impact analyses.

Operational noise levels would be relatively constant, thus multiple alternative energy facilities in close proximity could cause additive cumulative effects. The same can be said for the adverse impact of onshore lighting of landfalls and substations. The potential for cumulative impacts would be evaluated in site-specific environmental impact analyses.

All the sea turtles are classified as either threatened or endangered, although their worldwide distribution makes assessment of remaining numbers difficult (Plotkin 1995). In general, mortality to a few individual hatchlings or juveniles would be considered to have minor to moderate impacts, whereas taking of larger numbers of hatchlings or adults, or disruption of important nesting areas, would have moderate to major impacts. On the basis of their status as threatened or endangered, current cumulative impacts to sea turtles from all activities and processes are considered major. Additional adverse impacts from alternative energy facilities should be rigorously avoided or mitigated.

7.6.2.13 Coastal Habitats

The types of coastal habitats in the Atlantic, GOM, and Pacific regions are discussed in Sections 4.2.13, 4.3.13, and 4.4.13, respectively. Virtually all the activities and processes discussed in Section 7.6.1 could have adverse impacts on coastal habitats (e.g., oil and gas activities, commercial and recreational fishing, dredging, and military activities). Vessel traffic from all sources can generate waves that remove sediments along beaches, and any coastal construction involving land clearing, placement of fill material, or dredging can also result in loss of coastal habitat. Fuel spills from all sources could result in injury or loss of wetland vegetation or other coastal habitats.

Large oil spills from tankers or service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms) could have a major adverse impact on coastal habitats. Spills associated with alternative energy facilities are less probable than spills associated with tanker transport of oil and those associated with oil and gas production, and would also likely be smaller in volume. Such spills could contribute a minor amount to the impacts from spills from all activities on the OCS.

On the basis of the assessments in Sections 5.2.13, 5.3.13, and 5.4.13, impacts on coastal habitats from alternative energy facilities could be negligible to moderate, due to vessel traffic generating waves, accidental fuel spills, cable installation, and onshore construction. Multiple alternative energy facilities in close proximity would have additive effects from vessel traffic and cable landfall installations, although they may use existing infrastructure rather than require construction of new power stations. The probability of accidental spills also increases with increasing numbers of alternative energy facilities. Many existing activities impact coastal habitats. One or more alternative energy facilities would be expected to add minor additional impacts to these habitats, primarily because the majority of the activities would be occurring more than 3 nautical mi (3.5 mi; 5.6 km) from shore. The cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.14 Seafloor Habitats

Various types of seafloor habitats that support large numbers of species or unique species are described in Sections 4.2.14, 4.3.14, and 4.4.14, including topographic features, live bottoms, deepwater habitats, coral reefs, and submerged seagrass beds. Adverse impacts to species living in these habitats can be caused by a number of natural and man-made factors, including recent hurricanes, trawling, dredging, dredge material disposal, housing development, water quality degradation, levee construction, and ocean acidification. Any construction occurring on the seafloor disrupts seafloor habitats; in spite of the very large area available, adverse impacts can occur if the construction occurs in a localized special habitat. Ocean acidification due to increased atmospheric CO_2 could affect the process of calcification in corals and mollusks, adversely impacting tropical and subtropical coral reefs.

A large number of oil and gas-related structures are on the seafloor in the GOM, relatively fewer in the Pacific region, and none in the Atlantic region. The seafloor habitats of the Atlantic and Pacific regions contain large networks of communications cables (SAIC 2000; see also Section 4.2.20). These structures and activities can adversely affect benthic organisms by occupying their habitat and/or injuring them. However, there may be a positive impact for some benthic species due to the fact that certain types of fishing (e.g., trawling) may not be allowed or may not be preferred by fishermen over areas where cable is present, because of the risk of equipment hangup on exposed cable (Michel et al. 2007). The decreased fishing disturbance over cables belonging to any source (e.g., alternative energy facility transmission cable and telecommunications cables) could have a positive impact on benthic species living in the vicinity of these cables.

As discussed in Sections 5.2.14, 5.3.14, and 5.4.14, alternative energy facilities could have negligible to minor impacts on seafloor habitats, most notably from noise (e.g., from pile driving or drilling, laying cable in bedrock, and/or removal of structures using explosives), placement of meteorological towers, and the presence of new habitat (i.e., hard substrate platforms) in ecosystems. There could be major impacts to benthic communities if facilities were installed on uncommon or sensitive habitat. Siting of alternative energy facilities would be such that known sensitive habitats would be avoided, thus minimizing impacts to those habitats.

The introduction of many hard-substrate structures in a given area (e.g., multiple monopiles from a wind facility) could alter the ecosystem, because species requiring hard substrate will move into the area, possibly displacing other species. This effect could be cumulative, increasing in proportion to the number of structures in an area. Similarly, impacts to seafloor habitats from removal of multiple structures would be of concern for individual alternative energy facilities (particularly wind facilities because of the large number of turbine monopiles). It is unlikely, however, that two facilities near each other would undergo decommissioning at the same time, thus pile removal impacts would not be cumulative for multiple alternative energy facilities.

Many existing activities and processes impact seafloor habitats, including dredging, anchoring, trawling, artificial reef placement, and ocean acidification. One or more alternative energy facilities would be expected to add minor additional impacts to these habitats, assuming that mitigations such as avoidance of sensitive habitats were in place. The cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.15 Areas of Special Concern

Areas of special concern, including marine sanctuaries, National Park System lands, wildlife sanctuaries, and estuaries, are described in Sections 4.2.15, 4.3.15, and 4.4.15. For all types of activities on and near the OCS, impacts to areas of special concern are site-specific impacts that depend on the locations of facilities and activities.

Visual impacts to these areas may occur if facilities are sited in locations visible from park areas. Impacts could be cumulative if two or more facilities were visible from the same park or protected area. This would apply to any facility, including oil and gas platforms and alternative energy facilities. Impacts from single alternative energy facilities could be minor to moderate, as discussed in Section 5.2.15 for wind energy facilities; more than one facility visible from an area of special concern would increase the impacts.

Impacts from construction, other noise-generating activities, or activities that release wastes to the water (in State-regulated and OCS waters) are expected to be minimal, assuming that facilities would not be sited in the immediate vicinity of areas of special concern. This would apply to alternative energy facilities as well as to oil and gas facilities. Some short-term construction adverse impacts could occur if a transmission cable were placed close to an area of special concern. Assuming that vessels carrying large quantities of oil would avoid marine protected areas, large oil spills from any source should not have major impacts in marine protected areas.

Platforms on the OCS, for alternative energy facilities or other types of facilities, would introduce an artificial hard substrate that could be colonized by various types of fish and invertebrates. This could result in changes to local ecosystems and species diversity. Depending on the proximity of one or more alternative energy facilities with multiple platforms to offshore areas of special concern, there is a potential for interactions with fishery resources and ecological resources within nearby areas of special concern. Such interactions would not be expected to have adverse impacts on offshore areas of special concern, which are generally intended to protect natural communities associated with hard bottom habitats.

7.6.2.16 Military Use Areas

Section 4.2.16 describes the types of military uses that occur on the OCS and nearby coastal areas, including the establishment of danger zones and restricted areas used for testing and training. The military also has extensive radar systems in place along the U.S. coastline. Activities such as commercial and recreational fishing, oil and gas production, construction and operation of LNG facilities, and the laying of submarine cables are generally not allowed or are restricted in portions of some military use areas. Because relatively few tall structures (e.g., oil and gas platforms) are associated with these facilities and the structures are not densely grouped, they do not generally interfere with radar systems.

Potential conflicts of military use area with alternative energy facilities exist, because commercial alternative energy facilities could occupy relatively large areas of the ocean (e.g., the area of a commercial wind facility could be about 26 km^2 [10 mi^2]) and could impact the use of radar because the rotor height may exceed 122 m (400 ft). Such impacts to military uses would be additive if more than one alternative energy facility were located in a fairly small geographic area. Assuming that the siting of alternative energy facilities is coordinated with the USDOD, negligible to minor impacts on military use areas are expected.

7.6.2.17 Transportation

The amount of marine transport on the OCS is very large, as detailed in Sections 4.2.17, 4.3.17, and 4.4.17. There are also more than 22,000, 19,000, and 17,000 vessel calls per year received in Atlantic, GOM, and Pacific ports, respectively. About 600 vessel trips and 4,100 helicopter trips per day are expected over the next 40 years in association with oil and gas activities in the GOM alone (Table 7.6.1-2).

Transportation impacts from alternative energy facilities are anticipated to be negligible to minor, because relatively few vessel trips would be required during construction and operations, and existing ports and harbors could accommodate the additional volume without significant upgrades (see Sections 5.2.17, 5.3.17, and 5.4.17). The locations of alternative energy facilities should be selected so as not to interfere with designated fairways and shipping lanes as well as prime fishing areas. This may be difficult if several facilities are located in a small geographic area, resulting in cumulative adverse impacts to transportation. Cumulative impacts to transportation will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.18 Socioeconomic Resources and Environmental Justice

Waterborne commerce is an important component of the economies of most coastal communities. Other important economic drivers in these areas are agriculture, recreation, and tourism (see Sections 4.2.18, 4.3.18, and 4.4.18). Many seaboard ports are also well-developed, large industrial centers. The energy industry and oil and gas development are important sectors in the GOM.

As discussed in Sections 5.2.18, 5.3.18, and 5.4.18, site-specific impacts of alternative energy facilities on employment and income would depend on the number of people employed during construction and operations, and on the size of the populations in the areas where facilities were sited. In comparison with the OCS oil and gas activities, low numbers of employees are required to operate alternative energy facilities. Although multiple alternative energy facilities in the same geographic region would employ larger numbers, these numbers would still be small and cumulative impacts would be negligible. Environmental justice impacts are site-specific and would be assessed with specific projects.

7.6.2.19 Cultural Resources

Cultural resources on the OCS are discussed in Sections 4.2.19, 4.3.19, and 4.4.19. Possible sources of impacts to cultural resources on the OCS and in nearby coastal areas include storm damage, dredging (especially at harbor entrances), sand and gravel excavation, and drilling and rig placement for oil and gas development/production or LNG facilities. Oil spills could harm cultural resources, primarily because of unmonitored shoreline cleanup activities.

Site-specific archaeological surveys (or inventories for historic structures) would have to be conducted prior to construction of alternative energy facilities in areas that have the potential to contain intact cultural resources. If significant sites were identified, they would require either avoidance or mitigation measures prior to construction disturbance. Therefore, impacts would be site-specific and negligible to moderate (assuming that some mitigation measures would be more effective than others). Multiple alternative energy facilities would generally not result in additive cumulative impacts since all identified sites would be avoided or mitigated. However, if multiple facilities were located within visual range of a historically significant structure, there could be cumulative adverse impacts.

Overall, other activities and processes on the OCS would be the major contributors to potential adverse impacts on cultural resources; other anthropogenic activities, however, should also be required to have surveys to protect cultural resources prior to site disturbance. Oil spills associated with alternative energy facilities are less probable than oil spills associated with tanker transport of oil or with oil and gas production.

7.6.2.20 Land Use and Existing Infrastructure

Coastal areas support many varied uses, including marine transportation, tourism and recreation, oil and gas infrastructure, and residential areas (see Sections 4.2.20, 4.3.20, and 4.4.20). On the OCS and in nearby coastal waters, large areas are used for commercial and recreational fishing, and shipping lanes have been established. Although there are thousands of oil and gas platforms in the GOM, individually they occupy a relatively small surface area, and do not require large, if any, surrounding exclusion areas.

On the basis of conclusions from Sections 5.2.20, 5.3.20, and 5.4.20, impacts from alternative energy facilities to land use and existing infrastructure would be site-specific, but would be expected to be negligible to minor, assuming that existing uses and proposed plans are identified during siting and public concerns are considered. Onshore construction required for alternative energy facilities is expected to be minimal compared with construction required for other projects (e.g., coastal commercial and housing development projects and oil and gas support facilities).

Commercial shipping would be excluded from alternative energy facilities, and commercial and recreational fishing may also be excluded. These exclusion zones could result in cumulative impacts to shipping and fishing if multiple alternative energy facilities were located close together, or if other facilities with similar exclusions were located close to the alternative energy facilities. Cumulative impacts from such exclusion zones will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.21 Visual Resources

As noted in Sections 4.2.21, 4.3.21, and 4.4.21, ocean views are highly valued by residents and tourists. Existing structures on the OCS and in nearby coastal areas that can have visual impacts include oil and gas facilities and LNG facilities. Oil and gas structures are visible from shore in certain areas on the GOM and in the Pacific region.

Because of the height, size, and lighting of WTGs, impacts to visual resources may occur (see Section 5.2.21). The perception of visual impacts from wind turbines varies among viewers and may be positive or negative. If two or more wind energy facilities were sited within the same viewshed, cumulative impacts may be additive, depending on the local acceptance of this type of facility. Impacts from other types of alternative energy facilities would be negligible to minor as they do not protrude high above the ocean surface on the OCS.

Cumulative visual impacts would also occur if other facilities (e.g., oil platforms) were visible from shore within the same viewshed as alternative energy facilities. Mitigation of these impacts could be accomplished through siting facilities so that they would not be visible from shore or were away from sensitive areas. The potential for cumulative impacts from multiple facilities will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

Cumulative visual impacts could also occur from other activities, such as onshore development, commercial shipping, and commercial and recreational fishing/sightseeing, if those activities were visible from shore within the same viewshed as alternative energy facilities. Cumulative visual impacts associated with commercial shipping and commercial and recreational fishing/sightseeing would occur only when those activities took place near alternative energy facilities. Mitigation of these impacts could be accomplished through siting alternative energy facilities away from these activities so that the facilities and activities would not be simultaneously visible within viewsheds of sensitive areas.

7.6.2.22 Tourism and Recreation

Coastal areas support diverse recreational and tourist activities, including boating, swimming, surfing, sunbathing, fishing, and wildlife viewing as discussed in Sections 4.2.22, 4.3.22, and 4.4.22. Impacts on these activities from alternative energy development are discussed in Sections 5.2.22, 5.3.22, and 5.4.22. Coastal land development, oil and gas development, and LNG terminal development could also have site-specific adverse impacts on tourism and recreation. The range of potential cumulative impacts are primarily visual where wind technologies are developed (although there is also some research suggesting that wind energy facilities are attractive to tourists). Recreational boating, fishing, and diving impacts could occur if boating exclusion zones were established around alternative energy facilities; these could be mitigated through preconstruction consultation with the stakeholder groups, but would be cumulative if multiple facilities were sited in close proximity to one another. Other activities such as coastal land development and oil and gas development could also have site-specific adverse impacts on tourism and recreation; these impacts could add to impacts of alternative energy facilities if the facilities were located close together.

Cumulative impacts to tourism and recreation could occur if multiple alternative energy facilities or other industrial-type facilities were located close together. The level of impacts would depend on the local acceptance of these types of facilities. The potential for such cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.2.23 Fisheries

The existing status of fisheries is discussed in Sections 4.2.23, 4.3.23, and 4.4.23 for the Atlantic, GOM, and Pacific regions, respectively. Other activities that could have important impacts on OCS fisheries include oil and gas development activities, release of point-source and non-point-source effluents, sand and gravel excavation, military activities, laying of communications cables, and the construction of artificial reefs. These activities may impact fisheries by causing damage or loss of fishing equipment, alteration of commercial and recreational species habitats, toxicity to these species, and decreased catchability through creation of fishing exclusion zones.

On the basis of the assessments made in Sections 5.2.23, 5.3.23, and 5.4.23, impacts to fisheries from alternative energy facilities could be negligible to moderate. The same types of impacts as discussed above for other activities (e.g., damage or loss of equipment or vessels, alteration of habitat, and decreased catchability due to the creation of exclusion zones) could occur in association with alternative energy facilities.

Damage or loss of fishing equipment is mainly associated with trawling over unburied cables. The presence of cables can also lead to exclusion of fishing in the area over cables, because certain types of fishing may not be allowed or may not be preferred by fishermen, due to the risk of equipment hangup (Michel et al. 2007). Although much of the facility-to-shore transmission cable from alternative energy facilities would likely be buried, adverse impacts to fisheries could occur over sections of unburied cable. In general, the length of communication cable present on the seafloor is greater than the length of transmission cable that would be required for proposed alternative energy facilities. The adverse impact to fisheries from cables is additive; occurrence of equipment loss is more probable with increasing length of installed cable. The impact can be mitigated through burial of transmission cables wherever possible.

The introduction of many hard-substrate structures in a given area could alter ecosystems, because species requiring hard substrate could move into the area, possibly displacing other species. Introduction of hard-substrate structures would occur for all types of alternative energy facilities and for oil and gas development, LNG facility development, and artificial reef programs. If commercial fish species were impacted by the presence of these hard-substrate structures, the effects could be cumulative, increasing in proportion to the number of structures in an area.

Potential conflicts of fisheries with alternative energy facilities exist, because commercial facilities could create large fishing exclusion zones depending on the type of equipment used for the fishing activity (e.g., the exclusion zone could be the entire area of a commercial wind facility, about 26 km^2 [10 mi^2]). Also, assuming exclusion of commercial fishing within alternative energy facilities, increased fishing and shipping pressure may occur in areas outside of the facilities because of displacement of these activities from the exclusion areas. Such impacts to commercial fishing would be additive if more than one alternative energy facility were located in a fairly small geographic area. Fishing exclusion zones may also be associated with other activities such as military uses and oil and gas facilities.

Oil spills from tankers or service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms), could harm fisheries through fish kills or contamination of large numbers of fish. Any spills reaching shallow coastal marine habitats could have major impacts on fish species using these areas as juvenile nursery or spawning habitat (USDOI/MMS 2007b). Spills associated with alternative energy facilities are less probable than spills associated with tanker transport of oil and those associated with oil and gas production, and would also likely be smaller in volume. Because good spill prevention practices would be in place for alternative energy facilities, the probability of several spills occurring at around the same time and from multiple alternative energy facilities is very low; such spills would contribute a minor amount to the impacts from spills from all activities on the OCS.

Cumulative impacts to fisheries could occur if multiple alternative energy facilities or other activities were located close together. The types of impacts include space-use conflicts, additional fishing pressure on surrounding areas, artificial reef effects (wind facilities), and fish attraction to floating structures (wave facilities). The potential for such cumulative impacts will be evaluated in more detail in site-specific environmental reviews conducted for proposed projects.

7.6.3 Cumulative Impacts of Alternative Energy Development and Alternate Use of Existing Oil and Gas Platforms on the OCS under the Case-by-Case Alternative

Under the case-by-case alternative, the alternative energy and alternate use activities that would be the subject of approvals are the same as those of the proposed action. What differs is the process by which the MMS would approve such activities. Cumulative impacts result from the incremental impact of the case-by-case alternative when added to other past, present, and reasonably foreseeable future actions.

The alternative energy facilities and activities in the case-by-case alternative would be the same as in the proposed action. Alternate use facilities and activities would be the same as in the proposed action. The other past, present, and reasonably foreseeable future actions in the case-by-case alternative would be the same as those analyzed in the cumulative impacts analysis for the proposed action. Consequently, cumulative impacts under the case-by-case alternative would be the same as or similar to those identified under the proposed action as described in Section 7.6.2, because the impacts from the case-by-case alternative when added to past, present, and reasonably foreseeable future actions would be the same or similar. If the MMS accepts an application for an alternative energy or alternate use project under the case-by-case alternative, cumulative impacts would be assessed in the environmental analyses in relation to all other proposed projects in close proximity.

7.6.4 Cumulative Impacts of Alternative Energy Development and Alternate Use of Existing Oil and Gas Platforms on the OCS under the Preferred Alternative

The preferred alternative combines elements of the proposed action and the case-by-case alternative. The alternative energy and alternate use activities that would be the subject of approvals under the preferred alternative, the proposed action, and the case-by-case alternative are the same. What differs is the process by which the MMS would approve such activities. Cumulative impacts result from the incremental impact of the preferred alternative when added to other past, present, and reasonably foreseeable future actions.

The alternative energy facilities and activities in the preferred alternative would be the same as in the proposed action. Alternate use facilities and activities would be the same as in the proposed action. The other past, present, and reasonably foreseeable future actions in the preferred alternative would be the same as those analyzed in the cumulative impacts analysis for the proposed action. Consequently, cumulative impacts under the preferred alternative would be the same as or similar to those identified under the proposed action as described in Section 7.6.2, because the impacts from the preferred alternative when added to past, present, and reasonably foreseeable future actions would be the same or similar. If the MMS accepts an application for an alternative energy or alternate use project under the preferred alternative, cumulative impacts would be assessed in the environmental analyses in relation to all other proposed projects in close proximity.

7.7 OTHER NEPA CONSIDERATIONS

7.7.1 Unavoidable Adverse Impacts

The impacts associated with the proposed action are discussed in Chapter 5 for each of the alternative energy technologies considered, as are potential mitigation measures for each area of impact. Unavoidable adverse impacts are those impacts that cannot be mitigated by choices associated with siting and facility design options. They are impacts that would be unavoidable, regardless of the options selected.

Some unavoidable adverse effects on water and sediment quality, marine life, avian resources, and visual resources would be expected to occur as a result of the proposed action. For example, some bird strikes with WTGs would inevitably occur. However, the magnitude of the impacts and the degree to which they can be successfully mitigated would vary from project to project and site to site. These site-specific and species-specific issues would be addressed at the project level to maximize opportunities to mitigate impacts.

7.7.2 Relationship between Short-Term Uses of the Environment and Long-Term Productivity

Activities associated with alternative energy development on the OCS that could be considered to be short-term uses of the environment would include those limited activities that occur during the site monitoring, characterization, and testing phase and the short-term disturbance associated with construction and decommissioning activities. The impacts associated with short-term use of the environment during the site characterization and testing phase likely would be negligible, provided that significant disturbance of the seafloor does not occur. Environmental impacts during construction would be relatively short term and could likely be effectively mitigated as long as damage to unique or rare habitats and to long-lived species that regenerate especially slowly (e.g., corals) is minimized.

The impacts to the environment during operations would constitute a long-term use of the environment. Areas used for alternative energy projects may not be available for other uses (e.g., sand borrow sites) during the operation of the facility, but could be reclaimed following decommissioning. The MMS makes every attempt to minimize the environmental effects from operations. By adopting mitigating measures for OCS operations, the MMS attempts to minimize long-term impacts and maintain or enhance the long-term productivity of affected areas. Activities reasonably likely to result from the proposed action are expected to result in favorable short-term and long-term effects for the local and regional economies where alternative energy projects are located. These benefits include the creation of new employment and increased regional income, sales, and income tax revenues.

7.7.3 Irreversible and Irretrievable Commitment of Resources

The major irreversible and irretrievable commitments of natural and manmade resources related to the alternatives analyzed in this EIS are discussed below. A commitment of a resource is considered *irreversible* when the primary or secondary impacts from its use limit the future options for its use. An *irretrievable* commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations.

The development of alternative energy projects on the OCS would result in the consumption of sands, gravels, and other geologic resources, as well as fuel, structural steel, and other materials. Upon decommissioning, some of these materials would be available for reuse. Some water resources also would be consumed during the construction and, to a lesser extent, decommissioning phases.

In general, the impact to marine/biological resources would not constitute an irreversible and irretrievable commitment of resources. During construction, operation, and decommissioning, individual animals could be impacted. For most species, population-level effects would be unlikely. Site-specific and species-specific analyses conducted at the project level for all project phases would help ensure that the potential for such impacts would be minimized to the fullest extent possible. While marine habitat would be disturbed during construction and decommissioning, mitigation measures are expected to minimize impacts.

Impacts to visual resources in specific locations could constitute an irreversible and irretrievable commitment of resources. Efforts to mitigate these impacts would be undertaken at the project level with stakeholder input.

7.7.4 Mitigation of Adverse Effects

Chapter 5 includes a discussion of mitigation measures for each area of impact considered. Any potential adverse impacts that cannot be addressed at the programmatic level would be addressed at the project level where resolution of site-specific and species-specific concerns is more readily achievable. At the project level, the MMS would develop lease terms and stipulations that would incorporate mitigation measures.