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 Program on the Federal Outer Continental Shelf (OCS) and promulgation of associated regulations. The alternative energy program involves issuance of regulations related to granting leases, easements, or rights-of-way for the production of alternative energy on the OCS. Under the Alternate Use Program, activities involving the alternate use of existing oil and gas platforms could be permitted. In Section 7.1, the overall potential impacts (both positive and negative) of implementing the proposed action are addressed. Considered are the impacts from all 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; archaeological 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 and no action alternatives are also considered for comparison (Sections 7.2 and 7.3, respectively). Because the use 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 7.4. Cumulative impacts are discussed in Section 7.5, and other National Environmental Policy Act (NEPA) considerations are discussed in Section 7.6.

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) results from subsection 8(p) of the OCS Lands Act (OCSLA) and the requirement that the Secretary of the Interior or a delegated authority (i.e., the MMS) develop and issue any necessary regulations for implementing its new authority to regulate alternative energy activities on the OCS. The purpose of this action is to develop a program implementing MMS's new authority. Because this is a new program covering technologies that are still in their infancy, the evaluation is limited to current understanding and possible activities that may be initiated in a time frame of 5 to 7 years (2007–2014).

The development and issuance of regulations for all alternative energy projects proposed for the OCS would provide increased assurance that potential adverse effects on humans and biota from such projects would be thoroughly considered, and that appropriate and similar mitigation measures would be required for each project. The urgent 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 impacts from 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. The evaluation of impacts 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. For all resources of concern, mitigation measures would be used to minimize or avoid impacts.

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

- **Ocean surface and sediments:** Negligible to minor impacts to geologic features and processes. Impacts to coastal sedimentary processes 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.

- **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 oil spills occur due to collisions with facility structures or to failure of electric support platforms during storms.

- **Acoustic environment:** Minor to moderate adverse impacts to marine biota from the driving or drilling of monopiles, the laying of cable, and/or the use of explosives.

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

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

- **Marine mammals:** Possible moderate to major impacts for threatened and endangered 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).

- **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).

- **Terrestrial biota:** Negligible to moderate impacts from construction, operation, and decommissioning of onshore facilities.

- **Fish resources and Essential Fish Habitat:** Minor to moderate impacts from noise (e.g., pile driving or drilling, use of explosives); population-level effects unlikely.

- **Sea turtles:** Minor to major impacts from construction noise, onshore construction, onshore lighting, vessel and facility collisions, and entanglement in moorings (increased risk if density of structures is high).

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

- **Seafloor habitat:** Potentially major impacts from covering uncommon or sensitive seafloor habitat with facility structures, particularly for wind facilities with many structures and foundations; other impacts are negligible or minor.

- **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 size of population in area where facility is sited. Possible negligible to moderate sociocultural impacts.

- **Archaeological 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 and temporary impacts to beach recreation, sightseeing, diving, and recreational fishing.

- **Fisheries:** Negligible to minor 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, specific mitigation actions are recommended for each area of potential adverse impact. 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 regulations in place for granting leases, easements, or rights-of-way for any alternative energy facilities on the OCS. Most importantly, the regulations would likely decrease the environmental impacts from alternative energy facilities by including consistent stipulations for data collection, facility siting, mitigation, and ongoing impact evaluation for each facility. These regulations would also provide a roadmap for developers to follow during the permitting process, allowing developers to more adequately estimate the resources required for the proposed facility. This would, in turn, result in fewer failed proposals, since developers would know the requirements before investing in projects or locations that would ultimately prove unacceptable due to unforeseen adverse impacts. Overall, it would also be anticipated that having regulations in place for permitting alternative energy facilities on the OCS would result in decreased time to obtain permits, thereby facilitating development of the alternative energy industry on the OCS.

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 to unique geologic features, acceleration of erosion, alteration of topography, and interference with resource recovery would be negligible to minor. To avoid sediment transport problems in areas where loss of beach sand is a concern, site further 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.	Same as for wind energy. Also can mitigate sediment transport problems through appropriate configuring of 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 construction activities due to fugitive dust emissions from earthmoving and vehicle traffic. Mitigation measures include permitting requirements standard dust control practices, and vessel emission 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.
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 oil spills result from collisions with facility structures. Mitigate impacts through 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 much more limited (only for electric service platform [ESP]) so that impacts from sediment resuspension and use of drilling fluids would be lower.	Same as for wind energy (some technologies would require driving or drilling of monopiles, others would not).

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
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), which could cause minor to moderate impacts to marine biota (e.g., avoidance behavior, hearing loss to mammals, some killing of biota present at close range [within 50 m (164 ft) of pilings]). Mitigation measures can decrease impacts. Operational noise impacts to humans and biota depend on distance from receptors and are expected to be minor. Operational noise might induce avoidance in biota.	Construction and decommissioning could generate high-intensity noise (e.g., from laying cable in bedrock), although pile driving or drilling and removal would be more limited than for wind energy. This noise could cause minor to moderate impacts to marine biota. 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 could generate high-intensity noise (e.g., from pile driving or drilling, laying cable in bedrock, removal of pilings with explosives). This noise could cause minor to moderate impacts to marine biota. Low operational noise levels; minor impacts.
Hazardous materials and waste management	Minor to moderate impacts from spills during testing, site characterization, construction, operation, and decommissioning. 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.	Same as for wind energy.
Electromagnetic fields	Negligible impacts to human health or marine organisms.	Negligible impacts to human health or marine organisms.	Negligible impacts to human health or marine organisms.
Marine mammals	Potential moderate impacts to species that are threatened and endangered (e.g., some mysticetes, sperm whales) from noise from pile driving or drilling, 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 of migration routes, ceasing construction work when mammals are within 500 m (1,640 ft), and limiting types and size of explosives used. Assuming mitigation measures are employed, population-level impacts would not be expected.	Same as for wind energy, although acoustic impacts are less because pile driving or drilling is limited. Possible moderate to major impacts for threatened and endangered species from entanglement in moorings.	Same as for wind energy, except more potential moderate to major impacts from turbine strikes, particularly for endangered pinnipeds (e.g., Guadalupe fur seal), which could use the structures for prey haulouts. Potential mitigation through use of sonic pingers, design features to avoid use as haulouts.

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 moderate impacts due to turbine collisions for some species of marine and coastal birds and migrating species that fly over wind facilities (especially across the Gulf of Mexico). 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.	Same as for wind energy.	Same as for wind energy.
Fish resources and Essential Fish Habitat	Minor 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 unlikely. Mitigation measures include avoidance of sensitive fish habitats, deterring fish from the area prior to pile driving or explosive use, decreasing sound emissions, and development of hazardous materials and waste management plans.	Same as for wind energy, although acoustic impacts are less because pile driving or drilling is limited.	Same as for wind energy, although acoustic impacts are less because pile driving or drilling is limited.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Sea turtles	Minor to major impacts during testing, site characterization, construction, operation, and decommissioning (most notably from noise from pile driving or drilling, disorientation of hatchlings from offshore lighting, and/or removal of structures using explosives, vessel collisions, and onshore construction). Impacts from operational noise (wind turbines) unknown. Mitigation measures include avoidance of onshore nesting areas, ceasing construction work when turtles are within 500 m (1,640 ft), and limiting types and size of explosives used. Assuming 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. Additional mitigation measures include development and use of turtle exclusion devices.
Coastal habitats	Negligible to potentially major 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 sea-grass 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 covering 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, but impacts from covering habitat would be minor to moderate.	Same as for wind energy, but impacts from covering habitat would be minor to moderate.
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 are less.	Same as for wind energy, except potential impacts to visual resources are less.
Military use areas	Negligible to minor impacts during testing, site characterization, construction, operation, and decommissioning, assuming 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 of potential marine navigation and aviation hazards due to large height of towers through signage and/or lighting; also through siting away from significant flight paths.	Same as for wind energy, except no aviation hazards are expected.	Same as for wind energy, except no aviation hazards are 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 small, 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.
Archaeological resources	Site-specific potential negligible to moderate impacts associated with disturbance of sites; surveys would be required in areas with potential to contain intact archaeological resources. Mitigation for onshore sites expected to be easier and more effective than for offshore sites.	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 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 wave energy conversion (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 through siting away from sensitive areas.	Site-specific negligible to minor impacts due to low height of structures.	Site-specific negligible to minor impacts due to low height of structures.
Tourism and recreation	Minor and temporary impacts during testing, site characterization, construction, operation, and decommissioning to beach recreation, sightseeing, diving, and recreational fishing. Mitigation through siting away from sensitive areas.	Same as for wind energy.	Same as for wind energy.

TABLE 7.1.1-1 (Cont.)

Technical Area	Wind	Wave	Ocean Current
Fisheries	Site-specific potential negligible to minor 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 through use of navigational aids, adherence to Coast Guard-approved plans, and adherence to spill prevention and response plans.	Same as for wind energy.	Same as for wind energy.

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. 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. In addition, platform removal is costly. Removal costs can be mitigated by finding alternate uses for platforms. 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 alternative energy project would not only provide cost savings to platform operators and mitigate any removal impacts, but it would reduce impacts to the environment because installation of a new structure or facility is not necessary and emissions related to other energy sources would be reduced as discussed in Section 7.3. In addition, further disturbance of seafloor habitats or noise impacts from pile-driving activities, as discussed in Chapter 5, would be avoided. If the existing structure has a power cable connection to onshore facilities that is appropriate for sending the generated power onshore, then cable installation impacts could also be avoided.

Research and Monitoring—Similar cost savings and removal and installation impacts would 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 can be avoided if a platform is used 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 a facility is necessary to avoid moderate impacts such as pollution problems associated with feed and medication materials, and cultured species waste. Other potential problems that need attention include interference with native fish populations and predators.

7.2 IMPACTS OF THE CASE-BY-CASE ALTERNATIVE

The case-by-case alternative would be for the MMS to not develop the Alternative Energy and Alternate Use Program on the Federal OCS and not issue the associated rulemaking. This does not mean that such projects would not be permitted, but simply that there would be no general regulations governing such projects, so that the lease terms and stipulations put in place for different projects would be handled on a case-by-case basis. For example, the potential impacts from alternative energy facilities summarized in Section 7.1 would also be applicable for similar facilities permitted under the case-by-case alternative. Also, if alternate uses are proposed and permitted, the proposals would be evaluated and permitted on a case-by-case basis and the impacts would be similar to those discussed in Chapter 6.

The potential lack of consistency in MMS permitting of OCS alternative energy projects and alternate use projects that would result under the case-by-case alternative could have the following adverse impacts: (1) possible incomplete or inadequate preproject data collection requirements, resulting in poor siting decisions; (2) possible inconsistent or inadequate mitigation stipulations for some projects, leading to adverse environmental impacts; (3) increased permitting time, leading to increased costs for developers and delays in alternative energy production; and (4) confusion regarding the roles and responsibilities of various Federal, State, and local agencies with respect to regulation of the OCS alternative energy facilities and alternate use projects. Although the magnitude of such adverse impacts under the case-by-case alternative is not known, because the number of inquiries regarding leases, easements, and rights-of-way for new alternative energy projects and alternate use projects on the OCS is increasing, the likelihood of these adverse impacts is also increasing.

One consequence of delays in alternative energy production due to increased permitting times would be that the electricity thus not produced from OCS alternative energy facilities would have to be provided from other sources (e.g., coal-fired power plants or natural gas–fired plants). The potential adverse impacts associated with electricity production at these other types of facilities are discussed in Section 7.4. Another consequence of such delays would be that potentially beneficial alternate use of existing oil and gas facilities might not occur for some facilities.

7.3 IMPACTS OF THE NO ACTION ALTERNATIVE

Analysis of a no action alternative is required under NEPA. In this programmatic EIS, the no action alternative would be for the MMS to not exercise its discretionary authority under Section 388 of the Energy Policy Act to grant leases, easements, or rights-of-way for any alternative energy activities on the Federal OCS. The MMS would not develop the Alternative Energy and Alternate Use Program on the Federal OCS and not issue the associated rulemaking. In addition, the MMS would not authorize development of OCS alternative energy facilities on a case-by-case basis.

If the MMS failed to consider development of alternative energy projects on the Federal OCS, potentially significant offshore alternative energy resources in the United States would remain largely unexploited (individual States could still authorize development of offshore energy resources on State submerged lands). As a consequence, research and development of alternative energy technologies on the OCS would be reduced or discontinued, and assessments related to the amount of potential alternative energy available and the technological and economic feasibility of producing alternative energy on the OCS would be discontinued. Such a position would result in several adverse impacts, including: (1) elimination of a potentially significant option for meeting U.S. energy demand, and (2) reducing 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 would be increased, and the potential increase in liquefied natural gas (LNG) imports would further U.S. dependence on foreign sources of energy. Although the magnitude of such adverse impacts under the no action alternative is not known, because the number of inquiries regarding leases, easements, and rights-of-way for new alternative energy projects on the OCS is increasing, the likelihood of these adverse impacts is also increasing.

Another consequence of the no action alternative would be that the electricity thus not produced from OCS alternative energy facilities would have to be provided from other sources (e.g., coal-fired power plants or natural gas–fired plants). The potential adverse impacts associated with electricity production at these other types of facilities are discussed in Section 7.4.

In addition, under the no action alternative, there would be limited opportunities to employ existing oil and gas facilities located on the OCS for alternate uses. The impacts of this reduction would be to limit the research, development, and implementation of potentially beneficial alternate uses of these structures. If alternate use activities are not authorized under new subsection 8(p) of the OCSLA (Section 388 of the Energy Policy Act), only activities authorized under other provisions of the OCS Lands Act, 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 proposed for existing facilities on the OCS. Absent an approved alternate use, OCS facilities would be required to meet the existing requirements under 30 CFR 250, Subpart Q, Decommissioning Activities.

7.4 IMPACTS OF OTHER ENERGY SOURCES

If the regulations considered under the proposed action in this programmatic EIS were not issued, and if there were no proposals to develop alternative energy resources on the OCS, any increased demands on electricity supply would have to be met by 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 environmental impacts from other energy sources would depend on the fuel source, type of energy generation technology selected, size of the facility, and location. Because specific locations are not being proposed at this time, potential environmental impacts for other energy sources are discussed generically in this section.

To shed light on the future of energy supply and demand, 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 added in the future will include a mix of generating technologies. Of the new generating capacity 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 cost 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 7.3.1),
- Natural gas–fired plant generation (Section 7.3.2),
- Nuclear power plant generation (Section 7.3.3), and
- Other land-based generation systems, including hydro, wind, solar, geothermal, biomass, municipal solid waste, and fuel cells (7.3.4).

The order of presentation of energy sources 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 tax credits for investments in some technologies. In most instances, the energy sources considered in this section are well-established technologies that do not require demonstration-scale facilities prior to commercialization.

7.4.1 Coal-Fired Plant Generation

Coal-fired electric plants provide most 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 electric 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 (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 (Nuclear Regulatory Commission 1996). 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 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 (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. 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 eliminating the need for new transmission lines. Such colocation 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. Air quality would be impacted by the release of 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 identified 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 would 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 several hundred jobs, substantial tax revenues, and plant spending.

Worker risks associated with coal-fired plants result from 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 archaeological resources; changes in land use; and impacts on employment. Transportation of coal and limestone also result in air emissions. Socioeconomic benefits from several hundred mining jobs and tax revenues would also accompany the coal mining.

7.4.2 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 nonutility generators.

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 (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, 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 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). Unlike coal- and oil-fired plants, 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 Clean Air Act (CAA).

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 methane 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 (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.

7.4.3 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 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 have 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 (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 (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 (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 (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 archaeological 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 concerning the disposal of highly radioactive spent nuclear fuel generated by nuclear power plants. On February 15, 2002, based on 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.

7.4.4 Other Land-Based Generation Systems

7.4.4.1 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 (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.

7.4.4.2 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% in 2030 (EIA 2006). There is a 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 parks 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 park 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.

7.4.4.3 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 (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 were 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.

7.4.4.4 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 (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) (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. Soil erosion and stream sedimentation likely would result to some degree 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 constructing the geothermal facility. Some of the land originally cleared for construction of the geothermal facilities could probably be returned to previous uses, since it would not all have geothermal facilities located on it. 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, methane, 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 a considerable number of jobs accruing to local taxing jurisdictions from a geothermal plant.

7.4.4.5 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 nitrogen oxide (NO_x) emissions. In addition, biomass fueling has the potential to significantly reduce carbon dioxide (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 (Nuclear Regulatory Commission 1996).

7.4.4.6 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.

7.4.4.7 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).

7.4.5 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." That is, 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.

7.5 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. In order to address cumulative impacts of both alternative energy development on the OCS and alternate use of oil and gas platforms (Section 7.5.2), information is needed on past, present, and future activities and proposals for the OCS and nearby State-administered waters. Oil and gas production and transport activities are the most prevalent current and foreseeable use of the OCS. Information on both oil and gas activities and other activities on or near the OCS in the Gulf of Mexico and Pacific regions has been obtained from MMS's Oil and Gas Leasing Program EIS (USDOI/MMS 2002c) and the Gulf of Mexico (GOM) Multisale EIS (USDOI/MMS 2006p), and is summarized in Section 7.5.1. Information for the Atlantic region has been obtained from various MMS sources.

7.5.1 Past, Present, and Proposed Actions 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 that could result in cumulative impacts with the activities that would 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.

7.5.1.1 Oil and Gas Activities

7.5.1.1.1 Atlantic Region. 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. At this time, one new lease sale has been proposed for the Atlantic region (USDOI/MMS 2006a). This lease sale would result in a small amount of increased oil and gas activity, mainly drilling of exploratory wells in the near term. Although oil and gas activities in the Atlantic region are much more limited than in the GOM, a large oil spill from a platform, pipeline, or tanker could occur.

7.5.1.1.2 Gulf of Mexico. Exploration for offshore oil and gas has increased significantly in recent years, particularly in the GOM. There are approximately 3,900 operating oil and gas-related structures (includes platforms, well heads, and caissons) in the GOM region. Exploration and production of oil and gas in State-regulated coastal waters is ongoing in the GOM, particularly in Alabama, Louisiana, and Texas (e.g., about 100 rigs operating in Louisiana, 10 rigs in Texas, 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.

There is also 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 using U.S. ports, particularly large vessels.

The extent of cumulative projected development of oil and gas facilities in the Gulf of Mexico over the next 40 years is provided in Table 7.5.1-1. Development is expected to increase over the planning period, the total projected seafloor area to be disturbed for 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. There is a high probability that many large oil spills will occur in the GOM over the 60-year planning period, based on spill history (USDOI/MMS 2002c). Projected numbers and volumes of oil spills for the GOM region over a period of about 40 years are given in Table 7.5.1-1.

The central and western portions of the GOM have extensive onshore infrastructure (including gas processing plants, navigation channels, oil refineries, pipelines and pipeline

TABLE 7.5.1-1 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 (2006p), Tables 4-4 and 4-35, except where noted. Values applicable for a time period of 40 years; 2007-2046. Values in table are rounded to two significant figures.

[b] Source: USDOI/MMS (2006l), Tables IV-14 and IV-17.

landfalls, platform fabrication yards, and waste management facilities) to support oil and gas processing and transport, but there are very few such facilities in the eastern planning area (USDOI/MMS 2002c). Existing electricity distribution and fabrication facilities could potentially be used during construction of alternative energy facilities and for electricity distribution.

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 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 (USDOI/MMS 2002c). This facility handled about 1.2 million barrels (bbl) of imported oil per day in 2005, 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 2006p).

7.5.1.1.3 Pacific Region. 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 on the offshore Santa Maria Basin, 22 fields on the Santa Barbara Channel, and two fields on 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 of oil and 160,026 million ft^3 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 2002c). Eighty percent of this was received at the California ports.

7.5.1.2 Non–Oil-and-Gas Activities

Discussed in this section are alternative energy developments other than those discussed under the proposed action, dredging, point and non-point source effluents, Department of Defense activities, and other activities. There are also activities such as transportation, recreational or commercial fishing, boating, swimming, and surfing that occur in State waters and along coastlines that may add to cumulative impacts. Most of these activities are fairly common and widespread. The nature and extent of cumulative impacts resulting from them would be highly site dependent and would be addressed as part of the environmental reviews conducted for individual projects in the future.

Alternative Energy Development. Two wind energy development projects on the OCS are currently undergoing NEPA reviews. Individual States have also received applications for projects in State-regulated waters. A summary of the known proposed projects is provided in Table 7.5.1-2. Because these projects are either under development or reasonably foreseeable, they are appropriately considered for cumulative impacts.

TABLE 7.5.1-2 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 (LIPA)	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	MMS 2006o
Cape Wind	7.6 km (4.7 mi) offshore Cape Code Massachusetts, area of 62 km^2 (24 mi^2), North Atlantic region	130 turbines, 3.6 MW/turbine (total = 468 MW)	Wind	MMS 2006n
Galveston Offshore Wind LCC	11 km (7 mi) offshore of Galveston, TX	Total of 150 MW	Wind	Texas General Land Office 2005
Superior Renewable	5-13 km (3-8 mi) offshore of Padre Island, TX	Total of 500 MW	Wind	Superior Renewable Energy 2006
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 Park Facility (Ocean Power Technologies)	3.2 km (2 mi) offshore at Reedsport, Oregon, 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 and Newport Wave Park Facilities	Offshore near Coos Bay and Newport, Oregon	Total of 100 MW for each facility	Wave (PowerBuoy)	OPT 2007
Several	Variable distances off the coast of Florida	Unknown (8 preliminary permits issued	Ocean current	FERC 2007a

[a] OPT website 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).

At this time, 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 is 5–20 m (16–64 ft), and the depth requirements for wave energy conversion technologies range from 20–90 m (66–300 ft). However, the requirements for ocean current technologies range from about 18 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 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 likely area in which facilities will be located, they nonetheless allow for large distances between facilities.

Dredging. The Ocean Dumping Ban Act of 1988 prohibits the dumping of any municipal or industrial waste into the open ocean, so dredging is the only form (albeit indirect) of ocean dumping of these waste types. Dredging is routinely done for a variety of reasons (e.g., channel construction and maintenance, pipeline placement, creation of harbor and docking areas). Offshore disposal of dredge spoils is authorized under Title I of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 USC 1401) and the Federal Water Pollution Control Act, as amended (33 USC 1251). The USEPA has designated specific offshore sites in each of the USEPA Regions where this type of disposal can occur. There are regulated dredge disposal areas in Atlantic, GOM and Pacific regions; most of these are in State waters. For example, a large site in the Atlantic region is the Dam Neck site, which is located off of coastal Virginia and is 8 nautical mi^2 in size. Another is the New York Bight Dredged Material Disposal Site, which receives an average of 3.4 million m^3 (4.5 million yd^3) of dredge material each year (USEPA 2006c). There are 35 operational ocean disposal sites in the GOM, mostly in State waters, and in the Pacific region there are 31 ocean disposal sites; combined, these sites receive millions of cubic meters of dredge material annually (USDOI/MMS 2006l).

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 nonpoint sources of effluents to ocean waters include runoff and marine transportation vessels. runoff can contain a large variety of pollutants as listed for point sources above. Releases from marine vessels are generally petroleum hydrocarbons but could also include accidental release of sanitary wastes.

Department of Defense Activities. The U.S. Navy operates surface vessels, submarines, and aircraft between shore base locations and offshore waters in the Atlantic, GOM, and Pacific regions. There are 15 Navy bases near the Atlantic coast, 7 bases near the GOM coast, and 7 bases near the Pacific Coast (U.S. Department of the Navy 2004a). The U.S. Coast Guard (USCG) has several air stations and coastal facilities in each region (USCG 2006), from which it conducts both routine activities and search-and-rescue missions. The U.S. Air Force also maintains facilities in the GOM.

Other Activities. Sand and gravel excavation on the OCS occurs in all three regions managed by the MMS. There is also one producing sulfur lease located in Federal waters in the GOM, near the Mississippi River Delta. Subsidence of the seafloor in the vicinity of this platform could occur, which would affect nearby oil and gas or alternative energy facilities (USDOI/MMS 2002c).

Because imports of LNG are expected to double over the next 20 years, it is expected that new LNG terminals and facilities will be constructed on the OCS (USDOI/MMS 2006l). Eight facilities have been proposed for OCS waters; two for offshore of Boston, one for offshore Florida, one in the GOM, and three for offshore California (FERC 2007b).

One offshore LNG terminal already exists in the GOM. The Gulf Gateway facility, which began operation in 2005, is located 214 km (116 mi) of the coast of Louisiana. This facility offloads vaporized LNG from tankers into the existing offshore natural gas pipeline system. Environmental impacts associated with LNG facilities and transport include potential accidental releases resulting in explosions, fires, and/or cryogenic adverse effects in exposed organisms. However, many safety measures are required in the permitting process, and there is a very good safety record for LNG facilities and transportation (FERC undated).

Up to 250 million gal/d of seawater would likely be used in LNG facilities to raise the temperature of the LNG, which could cool the water by up to 20°F. This could have local environmental effects on marine biota, and effects could be cumulative if several new facilities were put into operation.

7.5.2 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 or alternate use program facilities are unknown. When such facilities are proposed, the cumulative impacts from all the facilities combined would be assessed in the environmental reviews for the proposed projects. This section addresses potential cumulative impacts in a generic manner.

Because neither the nature nor locations of future alternate use projects are known at this time, their cumulative impacts are not discussed. Such impacts would be considered during the evaluation and approval of actual proposed projects. Also, impacts from alternate uses in most cases are expected to be less than those from existing oil and gas platforms, as discussed in Section 7.5.1.1.

7.5.2.1 Ocean Surface and Sediments

Negligible to minor impacts from alternative energy facilities are expected with respect to unique geologic features, acceleration of corrosion, alteration of topography, and interference with resource recovery. To avoid sediment transport problems in areas where loss of beach sand is a concern, facilities should be sited further offshore (more than 2 km [1.2 mi]) and/or parallel to the direction of wave travel (particularly for wave energy facilities). Other activities that have an impact on ocean sediments are dredging and sand and gravel excavation.

7.5.2.2 Air Quality

Potential minor air quality impacts from OCS alternative energy facilities would be associated with construction of new onshore electricity distribution facilities (short-term exceedance of air quality standards for particulates). The probability that onshore construction will be required is higher if the new facilities will bring power to an area with a small population. Also, alternative energy facilities producing larger amounts of electricity will more likely need new onshore facilities.

Under certain conditions, alternative energy facilities may contribute to an exceedance episode in an ozone nonattainment area. Also, large alternative energy facility construction vessels using bunker fuels may occasionally contribute to exceedance of the 4% Prevention of Significant Deterioration (PSD) increment for SO_2 in nearby Class I areas.

As stated above, onshore construction activities would produce particulate emissions that could exceed air quality standards at the site perimeter for short periods of time. Generally, the impacts from separate construction activities are not cumulative, unless the activities occur at the same time and in close proximity. Therefore, the cumulative air quality impacts would be negligible.

Oil and gas production activities on the OCS produce criteria pollutant emissions. According to a recent draft EIS for the GOM, maximum allowable PSD increments for 24-h SO_2 and annual NO_2 may be exceeded due to oil and gas production activities on the OCS over the next 40 years (USDOI/MMS 2006p). Because alternative energy projects also may adversely impact Class I and nonattainment areas, environmental air impact analyses and mitigation measures will be developed for specific projects as appropriate. Other sources of emissions on the OCS include cargo vessels, oil tankers, commercial and recreational fishing boats, and military vessels. The relatively few required construction vessels and transport vessels for alternative energy facilities would also emit criteria pollutants. Offshore emissions from alternative energy facilities are expected to contribute a negligible amount to all existing sources of criteria pollutant emissions.

7.5.2.3 Ocean Currents and Movement

Minor to major impacts to ocean currents could occur for current energy conversion facilities that would cause a decrease in total current energy of 4% or more. These impacts would depend on the design of the technology, and the magnitude of impacts is uncertain. Although such a high level of development is not expected over the next 5 to 7 years, a reduction in current energy of that magnitude could result in large-scale changes in regional climate and ecology. Potential project-specific and cumulative impacts to ocean currents and movements from a large ocean current energy conversion facility would be evaluated in separate environmental analyses for that facility.

7.5.2.4 Water Quality

Minor impacts during construction, operation, and decommissioning of alternative energy facilities would be predicted, due to small spills of lubricants, solvents, etc., and resuspension of sediments. These types of impacts also occur in connection with oil and gas development and production, only to a far greater extent (see summary of projected oil and gas platform installation, drilling, and platform removal activities in Table 7.5.1-1). Increased turbidity would be caused by drilling and installation of platforms and pipelines. Impacts would be worse if the resuspended sediment were contaminated. Similar water quality impacts would also be associated with dredging and sediment disposal on or near OCS waters, and with municipal and industrial effluent outfalls into coastal waters. The overall water quality impacts from these activities would be minor to moderate, assuming that regulatory restrictions are followed. The contribution from construction, operation, and decommissioning of OCS alternative energy facilities to the total water quality impacts from effluents, small spills, and other activities that result in sediment resuspension is expected to be negligible.

As discussed in Section 7.1, the largest adverse water quality impacts associated with new OCS alternative energy projects under both the proposed action and no action alternatives would be from possible oil or transformer fluid spills due to collisions with facility structures or to failure of electric support platforms during storms. Oil spills could also 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 also as the number of permanent and mobile structures in State-regulated and OCS waters increases, so 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 (See Table 7.5.1-1). Mitigation measures to decrease the probability of oil spills include requirements for 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 due to 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.

7.5.2.5 Acoustic Environment

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 moderate impacts to marine biota (e.g., avoidance behavior, hearing loss to mammals, some killing of fish present at close range [within 50 m (164 ft) of pilings]). Constant noise would also be generated during operations. Oil and gas activities on the OCS and in State-regulated waters require similar noise-generating activities. For example, in the GOM each year, there might be about 80 new production structures constructed, 2,000 new wells drilled, up to 1,700 km (1,000 mi) of OCS pipeline laid, and 100 platforms removed using explosives (see Table 7.5.1-1). Other sources of noise include commercial and recreational fishing vessels, cargo vessels, and military vessels. These other activities in the GOM would be the major contributor to adverse acoustic impacts, with alternative energy facilities expected to contribute a negligible portion. However, with oil and gas development and production activities much more limited in the Atlantic OCS area and in the Pacific region, new alternative energy projects on the OCS in these areas would contribute a larger portion of the noise impacts. 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 site-specific environmental impact analyses.

7.5.2.6 Hazardous Materials and Waste Management

Minor to moderate impacts to resources could be associated with hazardous materials and wastes during testing, site characterization, construction, operation, and decommissioning of alternative energy facilities. These impacts would mainly be associated with accidental spills of dielectric fluids, fuels, and lubricants, and the magnitude of the impacts would depend on the size and location of a spill. The impacts from spills associated with alternative energy facilities are likely to contribute a minor amount to the impacts from spills from all activities on the OCS (about 50 large oil spills and about 2,700 smaller spills associated with OCS oil and gas facilities are expected over the next 40 years [Table 7.5.1-1]).

7.5.2.7 Electromagnetic Fields

Negligible impacts from electromagnetic (EM) fields on human health or aquatic species are expected in the vicinity of alternative energy facilities or associated submarine cables. EM fields from cable systems would have a very low energy content, and EM field sources from other OCS activities would be sufficiently distant that no cumulative impacts would be expected.

7.5.2.8 Marine Mammals

Potential moderate impacts may be associated with alternative energy facilities for species that are threatened or endangered (e.g., some mysticetes, sperm whales). These impacts would be from noise (e.g., from pile driving or drilling, laying cable in bedrock, removal of pilings using explosives), and from physical injuries from vessel strikes. There could also be moderate impacts from operational noise, especially for mammals with feeding areas, mating areas, or migratory routes intersected by the facility.

Noise sources and vessel trips are also associated with oil and gas development, commercial and recreational fishing, and cargo and military vessels. The GOM has a high level of oil and gas development on the OCS, which could also contribute to impacts to marine mammals. The Atlantic area and GOM and Pacific regions all host considerable commercial and recreational fishing both in State-regulated and coastal waters (see Sections 4.2.6, 4.3.6, and 4.4.6). The fishing vessels generate noise and may also strike marine mammals. The impacts of oil and gas development and marine traffic on marine mammals could include mortality for individuals, but the population-level impacts would depend on many factors (e.g., size and reproductive rates of affected stock, number, age, and size of animals affected) (USDOI/MMS 2006p). Impacts to marine mammals from alternative energy facilities are likely to contribute a minor proportion of the impacts.

7.5.2.9 Marine and Coastal Birds

Minor to moderate impacts to birds may be associated with onshore construction of facilities and cable landfalls from alternative energy facilities. There may also be negligible to moderate impacts from offshore construction depending on the habitats and birds affected, and minor to moderate impacts due to turbine collisions for some species of marine, coastal, and terrestrial birds that fly over wind facilities. Alternative energy facilities are likely to be a negligible to minor contributor to overall 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.

As stated in Section 5.2.10.4, there are hundreds of millions of bird strikes into communication towers, windows, electric transmission lines, and other structures each year; about 200,000 birds die from collisions with oil and gas platforms in the Gulf of Mexico alone. Additional wind parks, particularly in the Gulf of Mexico where so many oil platforms are already located, and new wind parks are proposed in State waters (see Table 7.5.1-2), would affect cumulative impacts by increasing 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. 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 wind turbine generators (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 parks were situated in migration pathways. Cumulative collision impacts to marine and coastal birds in the Atlantic area and the Pacific region would be of less concern because there are far fewer existing structures on the OCS in those areas, and plans for future development are more limited. 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.

7.5.2.10 Terrestrial Biota

Negligible to moderate impacts to terrestrial biota would be associated with alternative energy facilities from the operation of onshore facilities, and also from turbine collisions for terrestrial birds migrating over open waters (especially across the Gulf of Mexico; see Section 7.5.2.9 for discussion of cumulative impacts). Potential impacts from onshore operations would be from disturbance of terrestrial wildlife from operational noise and human activity. Operation of completed onshore facilities could result in the long-term avoidance of adjacent habitats by species sensitive to noise and human activity. There are many other potential sources of terrestrial biota disturbance onshore (e.g., commercial and residential developments, marine transport support facilities), with alternative energy facilities expected to contribute a minor portion. Potential cumulative impacts to terrestrial biota would be evaluated in site-specific environmental impact analyses.

7.5.2.11 Fish Resources and Essential Fish Habitat

Minor to moderate impacts to fish resources and essential fish habitat are expected in association with alternative energy facilities. These effects would mainly be from piling driving or drilling, laying of cable in bedrock, or removal of structures with the use of explosives. There could be localized moderate impacts on over-fished species (e.g., Pacific rockfish) from platform removals using explosives if several such removals occurred in close proximity to each other. In general, however, population-level impacts are unlikely. Oil and gas activities on the OCS and in State-regulated waters require similar noise-generating activities and are expected to be much more prevalent than activities associated with alternative energy facilities. The cumulative impacts on fish resources and Essential Fish Habitat are expected to be minor to moderate.

7.5.2.12 Sea Turtles

Minor to major impacts to sea turtles could be associated with alternative energy facilities, most notably from noise (e.g., from pile driving or drilling, laying cable in bedrock, and/or removal of structures with explosives), onshore lighting, vessel collisions, and onshore construction. Oil and gas activities on the OCS and in State-regulated waters require similar activities.

The major cause of death for sea turtles in the United States and the Gulf of Mexico is capture and drowning in commercial fishing gear (National Research Council 1990). Activities that can 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 can cause increased toxicity in sea turtles due to long-term bioaccumulation. Although cumulative adverse impacts to sea turtles from all activities in the Atlantic area and GOM and Pacific regions are expected to be moderate with mitigation (some animal mortality and reduction in habitat), the contribution to these impacts from alternative energy facilities would be minor.

7.5.2.13 Coastal Habitats

Negligible to potentially major impacts to coastal habitats from alternative energy facilities could occur due to vessel traffic generating waves, accidental fuel spills, dredging, cable-installation, and onshore construction resulting in habitat fragmentation and altered hydrology. Oil and gas activities on the OCS and in State-regulated waters can require similar near-shore and onshore activities. Vessel traffic from all sources can generate waves that remove sediments along beaches, and any 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 mortality of wetland vegetation or wildlife. Ongoing commercial shipping, commercial and recreational fishing, oil and gas production activities, and coastal construction projects would be the major contributor to adverse impacts to coastal habitats, with alternative energy facilities contributing a negligible portion.

7.5.2.14 Seafloor Habitats

Minor to major impacts to seafloor habitats could be associated with alternative energy facilities, 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 EM fields around cables. Oil and gas activities on the OCS and in State-regulated waters require similar structures and noise-generating activities. There are a large number of oil and gas-related structures on the seafloor in the GOM, relatively fewer in the Pacific region, and very few 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. EM fields also can disorient some ray and shark species. Other activities (e.g., vessel traffic, release of effluents into State-regulated and Federal waters, and dredging) could also adversely affect seafloor habitats. Current cumulative impacts to seafloor habitats in the three regions are likely to be minor to moderate; new alternative energy facilities would likely contribute a minor portion of the cumulative impacts, but could contribute to moderate to major impacts in localized areas.

7.5.2.15 Areas of Special Concern

For all types of activities on and near the OCS, impacts to areas of special concern are site-specific impacts that depend on locations of facilities and activities. For wind facilities, minor to moderate impacts to visual resources could occur if wind towers are visible from coastal parks. Similar visual impacts would occur if oil platforms or other facilities were placed in locations visible from park areas. Impacts would be cumulative if two or more facilities were visible from the same park or protected area.

Impacts from construction, other noise-generating activities or activities that release wastes to the water (in State-regulated and OCS waters), and EM fields around transmission cables and pipelines are expected to be minimal assuming that facilities would not be sited in the immediate vicinity of special marine-protected areas. 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.

7.5.2.16 Military Use Areas

Negligible to minor impacts on military use areas are expected in association with alternative energy facilities, assuming that the siting of facilities is coordinated with the USDOD. Other activities on the OCS, including commercial and recreational fishing, oil and gas production, and the laying of submarine cables, would be the major contributors to potential adverse impacts to military use areas, with alternative energy facilities contributing a negligible portion to impacts.

7.5.2.17 Transportation

Negligible to minor impacts on transportation would be expected in association with alternative energy facilities, because existing ports and harbors could accommodate additional volume without significant upgrades. The contribution to offshore transportation from alternative energy facilities is negligible in comparison with other activities (e.g., 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 7.5.1.1]; more than 22,000, 19,000, and 17,000 vessel calls per year are received in Atlantic, GOM, and Pacific ports, respectively).

7.5.2.18 Socioeconomic Resources and Environmental Justice

Site-specific impacts of alternative energy facilities on jobs and income would depend on size of the populations in the areas where facilities were sited. Other coastal activities and activities in State-regulated and Federal waters employ far greater numbers of people than alternative energy facilities will employ. The contribution of alternative energy facilities to cumulative regional socioeconomic impacts is expected to be negligible. Environmental justice impacts are site-specific and would be assessed with specific projects.

7.5.2.19 Archaeological Resources

Site-specific negligible-to-moderate impacts may be associated with disturbance of sites related to alternative energy facilities; surveys would be required in areas with potential to contain intact archaeological resources. Other possible sources of impacts to archaeological resources include storm damage, dredging (especially at harbor entrances), and drilling and rig placement for oil and gas development/production. Oil spills could harm archaeological resources, primarily due to unmonitored shoreline cleanup activities. Oil spills associated with alternative energy facilities are less probable than oil spills associated with tanker transport of oil and those associated with oil and gas production and are less likely to occur in shallow coastal areas where archaeological resources are found. Overall, other activities on the OCS (e.g., dredging, oil and gas development) would be major contributors to site-specific moderate adverse impacts on archaeological resources, with alternative energy facilities contributing a minor portion of the impacts.

7.5.2.20 Land Use and Existing Infrastructure

Impacts to land use and existing infrastructure are site-specific, but would be negligible to minor from alternative energy facilities, 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 negligible compared with construction required for other projects (e.g., coastal commercial and housing development projects, 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 other facilities with similar exclusions were located close to the alternative energy facilities. These cumulative site-specific potential land-use impacts are expected to be negligible to minor and would be assessed with specific projects.

7.5.2.21 Visual Resources

Because of the height and size of wind turbine generators, impacts to visual resources may occur. The perception of visual impacts varies among viewers and may be positive or negative. Impacts from other alternative energy facilities are unlikely as they do not protrude high above the ocean surface on the OCS.

Visual impacts would also occur if other facilities (e.g., oil platforms) were placed in locations visible from the shore; these impacts would be cumulative if two or more facilities could be seen from the same location. 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.

7.5.2.22 Tourism and Recreation

Negligible to minor impacts on tourism and recreation are expected in association with alternative energy facilities. These minor impacts could occur in the areas of beach recreation, sightseeing, diving, and recreational fishing and could be mitigated through siting facilities away from sensitive areas. Impacts from alternative energy facilities would contribute only a negligible amount to the total impacts from other coastal and OCS activities (e.g., coastal land development, oil and gas development).

7.5.2.23 Fisheries

Minor to moderate impacts to fisheries from alternative energy facilities could occur due to decreased catchability, decreased access to fishing areas, and damage or loss of equipment or vessels. Similar impacts could be associated with other facilities located on or near the OCS (e.g., oil and gas development facilities, pipelines), and moderate to major cumulative impacts to fisheries could occur if activities with similar impacts affected the same fish populations. Some wave or ocean current alternative energy technologies also may cause impingement or entrapment of fish, although this would not be expected to result in population-level impacts.

Oil spills could also harm fishery resources 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 2002c). However, oil spills associated with alternative energy facilities would have a higher probability of occurring in deeper offshore waters where impacts to fisheries would be lower. Oil spills associated with alternative energy facilities are less probable than oil spills associated with tanker transport of oil and those associated with oil and gas production, and, therefore, alternative energy facilities are expected to contribute only a small portion to major adverse impacts to fisheries from potential large oil spills.

7.6 OTHER NEPA CONSIDERATIONS

7.6.1 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 in order to maximize opportunities to mitigate impacts.

7.6.2 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 significant disturbance of the seafloor does not occur. Environmental impacts during construction would be relatively short term and could likely be effectively mitigated.

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 burrow 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. The proposed action would 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 jobs and increased regional income, sales, and income tax revenues.

7.6.3 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.

7.6.4 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 regulations and stipulations that require lessees or operators to develop monitoring programs to evaluate the environmental conditions at the site through all phases of development, to establish metrics against which monitoring observations can be measured, to identify potential mitigation measures, and to establish protocols for incorporating monitoring observations and new mitigation measures into standard operating procedures.