

GAO

Report to the Subcommittee on
Readiness, Committee on Armed
Services, House of Representatives

February 2009

DEFENSE MANAGEMENT

DOD Needs to Increase Attention on Fuel Demand Management at Forward-Deployed Locations



G A O

Accountability * Integrity * Reliability


GAO
 Accountability-Integrity-Reliability
Highlights

Highlights of [GAO-09-300](#), a report to the Subcommittee on Readiness, Committee on Armed Services, House of Representatives

Why GAO Did This Study

The Department of Defense (DOD) relies heavily on petroleum-based fuel to sustain its forward-deployed locations—particularly those that are not connected to local power grids. While weapon platforms require large amounts of fuel, DOD reports that the single largest battlefield fuel consumer is generators, which provide power for base support activities such as cooling, heating, and lighting. Transporting fuel to forward-deployed locations presents an enormous logistics burden and risk, including exposing fuel truck convoys to attack. GAO was asked to address DOD's (1) efforts to reduce fuel demand at forward-deployed locations and (2) approach to managing fuel demand at these locations. This review focused on locations within Central Command's area of responsibility. GAO visited DOD locations in Kuwait and Djibouti to learn about fuel reduction efforts and challenges facing these locations.

What GAO Recommends

GAO recommends that DOD establish an effective approach to managing fuel demand at forward-deployed locations by developing fuel demand management requirements; designating the new director of operational energy as the lead proponent of fuel demand management at forward-deployed locations; addressing demand management shortcomings in DOD's energy strategy; and establishing military department oversight of fuel demand issues. DOD generally concurred with the recommendations.

To view the full product, including the scope and methodology, click on [GAO-09-300](#). For more information, contact William M. Solis at (202) 512-8365 or solisw@gao.gov.

DEFENSE MANAGEMENT

DOD Needs to Increase Attention on Fuel Demand Management at Forward-Deployed Locations

What GAO Found

DOD components have some efforts under way or planned to reduce fuel demand at forward-deployed locations. Many of these efforts are in a research and development phase, and the extent to which they will be fielded and under what time frame is uncertain. Notable efforts include the application of foam insulation to tent structures (see fig.), the development of more fuel-efficient generators and environmental control units, and research on alternative and renewable energy sources for potential use at forward-deployed locations. In addition, during visits to Kuwait and Djibouti, GAO met with officials about local camp efforts aimed at reducing fuel demand.

Figure: Tent before Application of Foam Insulation and Tent after Application of Foam Insulation



Source: DOD Power Surety Task Force.

DOD lacks an effective approach for implementing fuel reduction initiatives and maintaining sustained attention to fuel demand management at its forward-deployed locations. Moreover, DOD faces difficulty achieving its goals to reduce dependence on petroleum-based fuel and its logistics "footprint," as well as operating costs associated with high fuel usage, because managing fuel demand at forward-deployed locations has not been a departmental priority and fuel reduction efforts have not been well coordinated or comprehensive. GAO found that DOD's current approach to managing fuel demand lacks (1) guidance directing locations to address fuel demand, (2) incentives and a viable funding mechanism to invest in fuel reduction projects, and (3) visibility and accountability for achieving fuel reduction. Although it may not be practical for DOD to decrease fuel usage at every forward-deployed location and base commanders must place their highest priority on meeting mission requirements, fuel demand is likely to remain high until the department gives systematic consideration to incorporating fuel demand in construction, maintenance, procurement, and other policy decisions for forward-deployed locations. The 2009 defense authorization act requires DOD to establish a director of operational energy and an energy strategy, providing the department with an opportunity to increase attention on improving fuel demand management.

Contents

Letter		1
	Results in Brief	3
	Background	6
	DOD Components Have Initiated Efforts to Reduce Fuel Demand at Forward-Deployed Locations	12
	DOD Does Not Have an Effective Approach for Managing Fuel Demand at Forward-Deployed Locations	19
	Conclusions	34
	Recommendations for Executive Action	35
	Agency Comments and Our Evaluation	36
Appendix I	Fuel Demand at Selected DOD Forward-Deployed Locations during June 2008	40
Appendix II	Scope and Methodology	48
Appendix III	Selected Initiatives of the DOD Power Surety Task Force to Reduce Fuel Demand at Forward-Deployed Locations	51
Appendix IV	Comments from the Department of Defense	55
Appendix V	GAO Contact and Staff Acknowledgments	58
Tables		
	Table 1: Responsibilities for Bulk Petroleum in Support of Military Operations	33
	Table 2: Fuel Consumption Reported by Selected Forward-Deployed Locations for June 2008	41

Figures

Figure 1: Fuel Storage and Delivery for Military Operations	8
Figure 2: Tent before Application of Foam Insulation and Tent after Application of Foam Insulation	13
Figure 3: Improved Environmental Control Unit	15
Figure 4: Renewable Energy Tent City at Tyndall Air Force Base, Florida	16
Figure 5: Deployable Renewable Energy Alternative Module Prototype	17
Figure 6: Byproducts of Scrap Tire Recycling Process	18
Figure 7: Proportion of Fuel Consumption Reported for Base Support Activities and for Air and Ground Operations by Selected Forward-Deployed Locations for June 2008	42
Figure 8: Camp Lemonier	43
Figure 9: Q-West Air Base	44
Figure 10: Camp Arifjan	45
Figure 11: Contingency Operating Base Adder	46
Figure 12: Bagram Air Field	47
Figure 13: Eskimo Spray Foam Insulation	51
Figure 14: Transportable Hybrid Electric Power Stations (THEPS)	51
Figure 15: Net Zero Plus Joint Capability Technology Demonstration	52
Figure 16: Monolithic Dome	52
Figure 17: Tactical Garbage to Energy Refinery (TGER)	53
Figure 18: Hybrid Electric Power Station	53
Figure 19: Power Surety Feasibility Assessment	54

This is a work of the U.S. government and is not subject to copyright protection in the United States. The published product may be reproduced and distributed in its entirety without further permission from GAO. However, because this work may contain copyrighted images or other material, permission from the copyright holder may be necessary if you wish to reproduce this material separately.



United States Government Accountability Office
Washington, DC 20548

February 20, 2009

The Honorable Solomon P. Ortiz
Chairman
The Honorable J. Randy Forbes
Ranking Member
Subcommittee on Readiness
Committee on Armed Services
House of Representatives

The Department of Defense (DOD) depends heavily on petroleum-based fuel to sustain its forward-deployed locations around the world—particularly those locations that are not connected to local power grids and must rely on fuel-consuming generators for heating/cooling, lighting, and other base support activities.¹ Each day, over 2 million gallons of jet fuel alone are supplied to U.S. forces in Iraq and Afghanistan.² Transporting large quantities of fuel to forward-deployed locations presents an enormous logistics burden and risk. In 2006, a senior U.S. commander in Iraq submitted an urgent request to DOD for renewable energy systems in order to reduce supply line vulnerabilities associated with the military’s dependence on fuel for power generation at forward-deployed locations. Furthermore, global oil supply routes are vulnerable because they flow through unstable regions. High fuel demand, coupled with the recent volatility of fuel prices, also have significant implications for DOD’s operating costs. With the ongoing Global War on Terrorism, which DOD officials have referred to as “the longer war,” the department may need to sustain many of its forward-deployed locations supporting current operations for longer than initially anticipated.

This report is the third in a series of studies requested by the Subcommittee on Readiness of the House Committee on Armed Services examining DOD’s energy usage for military operations. Our March 2008

¹DOD distinguishes between mobility energy—the energy required for moving and sustaining forces and weapons platforms for military operations—and facility energy—the energy consumed at fixed installations. Mobility energy, also known as operational energy, includes the energy used to sustain forward-deployed locations and constitutes about 75 percent of DOD’s total energy use.

²DOD uses jet fuel (such as JP8) for a wide range of fuel needs, not just for aircraft. DOD also uses diesel fuel and other types of petroleum-based fuel at its forward-deployed locations.

report found that while DOD and the military services have several efforts under way to reduce energy used for military operations, the department lacks key elements of an overarching organizational framework to manage mobility energy matters across the department.³ We also testified last March on the need for DOD to establish an overarching organizational framework, including an executive-level Office of the Secretary of Defense (OSD) official who is accountable for mobility energy.⁴ This report addresses DOD's (1) efforts to reduce fuel demand at forward-deployed locations and (2) approach to managing fuel demand at these locations. We are also providing information on DOD's fuel demand at selected forward-deployed locations (see app. I). We focused our review on forward-deployed locations within Central Command's area of responsibility.⁵ Central Command has more than 400 forward-deployed locations in Iraq and Afghanistan, as well as locations in other countries.

To address our objectives, we analyzed DOD and military service guidance, relevant legislation, and other documents and discussed fuel demand issues with agency officials to gain their perspectives. Our review focused on forward-deployed locations—DOD installations or base camps situated outside of the United States that support current operations—that relied primarily on fuel-based generators, as opposed to local power grids.⁶ We asked officials to identify for us key efforts planned or under way to reduce fuel demand. After consultation with Central Command officials, we selected and visited two forward-deployed locations—Camp Arifjan, an Army facility in Kuwait and Camp Lemonier, a Navy facility in Djibouti—to gain a firsthand understanding of fuel demand reduction efforts and challenges facing these locations.⁷ We chose to visit these

³GAO, *Defense Management: Overarching Organizational Framework Needed to Guide and Oversee Energy Reduction Efforts for Military Operations*, [GAO-08-426](#) (Washington, D.C.: Mar. 13, 2008).

⁴GAO, *Defense Management: Overarching Organizational Framework Could Improve DOD's Management of Energy Reduction Efforts for Military Operations*, [GAO-08-523T](#) (Washington, D.C.: Mar. 13, 2008).

⁵Central Command, one of DOD's six geographic combatant commands, has an area of responsibility that encompasses over 25 countries including locations in the Middle East, South Asia, and Central Asia.

⁶We excluded Navy vessels from the scope of our review.

⁷At the time of our visit in June 2008, both camps were under Central Command's area of responsibility. On October 1, 2008, DOD transferred Camp Lemonier under its newly established Africa Command.

locations because they relied heavily on fuel-based generators to carry out very different missions—the former directly supported operations in Iraq while the latter provided diplomatic, development, and counterterrorism support within the Horn of Africa. In assessing DOD’s approach to managing fuel demand at forward-deployed locations, we reviewed documents and held discussions with agency officials on issues including forward-deployed location construction and maintenance, procurement, and funding procedures. For comparison purposes, we reviewed DOD guidance related to energy reduction for the department’s permanent or U.S. facilities.

We conducted our review from March 2008 through February 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. Details about our scope and methodology are contained in appendix II.

Results in Brief

DOD components have efforts under way or planned to reduce fuel demand at forward-deployed locations. Many of these efforts are in a research and development phase, and the extent to which they will be fielded and under what time frame is uncertain. For example, one mission of the DOD Power Surety Task Force, created in 2006, is to identify and demonstrate emerging or commercial off-the-shelf technology that can reduce DOD’s fuel demand. Power Surety Task Force officials told us that, based on results from a recent demonstration, the department decided to pursue a large-scale effort to apply foam insulation to temporary structures, such as military tents, in Iraq to reduce the number of fuel-based generators needed to power these structures at forward-deployed locations. Another DOD office is developing a new generation of fuel-efficient generators and environmental control units for use at forward-deployed locations. The military services are also researching the use of alternative and renewable energy sources for power generation. Moreover, during our visits to two forward-deployed locations, we observed local efforts to reduce fuel demand. At Camp Arifjan, Kuwait, for example, Army officials shared plans to consolidate the loads on small individual generators by creating groupings of larger generators, which could improve the overall efficiency of generator usage and reduce the number of generators that must operate during most times of the year. At Camp Lemonier, Djibouti, foam insulation had been applied to the tent exterior

of the camp's gymnasium, which Navy officials told us reduced by 40 percent the number of fuel-based generators needed to power the facility.

While these efforts show potential for achieving greater fuel efficiency, DOD lacks an effective approach to managing fuel demand that could enable the widespread implementation of fuel reduction initiatives and sustained attention to fuel demand issues at its forward-deployed locations. DOD has stated that it needs to reduce its reliance on petroleum-based fuel and minimize the logistics "footprint" of military forces. However, DOD faces difficulty in achieving these goals because managing fuel demand at forward-deployed locations has not been a departmental priority and its fuel reduction efforts have not been well coordinated or comprehensive. More specifically, we found that DOD lacked guidance directing forward-deployed locations to address fuel demand, incentives and a viable funding mechanism for locations to invest in fuel reduction initiatives, and visibility and accountability within the chain of command for achieving fuel reduction.

- **Lack of guidance:** DOD generally lacks guidance that directs forward-deployed locations to manage and reduce their fuel demand—at the department level, combatant command level, and military service level. DOD is driven to address energy issues—such as incorporating energy efficiency into repair and construction projects, procuring energy-efficient products when cost effective, and tracking and measuring its progress and energy efficiency improvement—at its U.S. installations largely by federal mandates and DOD guidance. However, agency officials were unable to identify similar guidance for forward-deployed locations, and they told us that reducing fuel use has been a low priority compared with other mission requirements. Our analysis of combatant command and military service guidance related to forward-deployed location construction showed that the existing guidance is largely silent with respect to fuel demand management and energy efficiency. The Joint Staff has begun an effort to develop common living standards (e.g., square footage for living space per person, duration of showers) for military servicemembers at forward-deployed locations that presents an opportunity to make decisions that take into account fuel demand considerations, but Joint Staff officials told us that fuel reduction has not been considered in this effort to date.
- **Lack of incentives and viable funding mechanism:** DOD encourages fuel reduction projects at its permanent installations but has not established incentives or a viable funding mechanism for investing in such projects at its forward-deployed locations. Officials at Camp Lemonier, for example, have identified several projects that would reduce the camp's

fuel demand but told us they saw little “return on investment” for them to undertake such projects because they would not receive the associated savings for use toward other camp improvements. Moreover, many of DOD’s forward-deployed locations rely heavily on funding from supplemental appropriations related to the Global War on Terrorism, and delays in receiving this funding can present challenges in covering existing costs, making it difficult for commanders to fund more expensive fuel reduction projects. Funding mechanisms exist to promote energy reduction projects at permanent DOD installations, including an energy conservation program and energy-performance saving contracts with private sector firms. Without incentives and a viable funding mechanism, commanding officials at DOD’s forward-deployed locations are unlikely to identify fuel reduction as a priority for making a significant investment of resources.

- **Lack of visibility and accountability:** DOD’s current organizational framework does not provide the department visibility for fuel demand issues at its forward-deployed locations. We found that information on fuel demand management strategies and reduction efforts is not shared among locations, military services, and across the department in a consistent manner. Moreover, DOD guidance does not designate any DOD office or official as being responsible for fuel demand management at forward-deployed locations, and we could not identify anyone who is specifically accountable for this function through our interviews with various DOD and military service offices. The Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 requires DOD to establish a Director of Operational Energy Plans and Programs, an operational energy strategy for DOD, and military department-level energy officials.⁸ DOD has not yet established a director or strategy for operational energy. In meeting the requirements, DOD has an opportunity to improve visibility and accountability for fuel demand management at forward-deployed locations.

Until DOD makes fuel demand management a higher priority and establishes a more coordinated and comprehensive approach to managing forward-deployed location fuel demand—with guidance, incentives, a viable funding mechanism, visibility, and accountability—the department cannot be assured that good fuel reduction practices are identified,

⁸The act defines operational energy as the energy required for training, moving, and sustaining military forces and weapon platforms for military operations; it includes energy used by tactical power systems, generators, and weapon platforms.

shared, prioritized, resourced, implemented, and institutionalized across locations. Establishing such an approach could enable the department to reduce the amount of fuel that must be delivered to forward-deployed locations, decrease the department's reliance on petroleum-based fuel and the logistics footprint, and save on fuel costs.

We are making recommendations that DOD components develop requirements and guidelines on fuel demand management at forward-deployed locations. In addition, we are recommending that DOD designate the new, congressionally-mandated director of operational energy as the department's lead proponent of fuel demand management at forward-deployed locations and that the director, in establishing a departmentwide operational energy strategy, address the shortcomings related to managing fuel demand at forward-deployed locations that we have identified in this report. Finally, we are recommending that the military departments' senior energy officials be assigned, among their other duties, responsibility for overseeing fuel demand management at forward-deployed locations within their respective services. In commenting on a draft of this report, DOD generally concurred with our recommendations. DOD's comments are reprinted in appendix IV.

Background

DOD's Forward-Deployed Locations

At any given time, the United States has a large portion of its military personnel serving abroad in forward-deployed locations. The forward presence of military forces at overseas locations is critical to supporting U.S. strategic interests. Forward-deployed forces provide the basic building blocks with which to project military power in crises and strengthen U.S. military access. While the numbers of personnel and locations vary with the frequency and types of military operations and deployment demands, military operations in Iraq and Afghanistan have led to the creation of several hundred new locations.⁹ Operational control of U.S. military forces at forward-deployed locations is assigned to the nation's six geographic, unified overseas regional commands, which include Central Command. For current operations, Central Command has identified the need for forward-deployed locations within its area of

⁹According to Central Command, as of November 2008, there were more than 300 forward-deployed locations in Iraq and more than 100 in Afghanistan, in addition to locations in other countries.

responsibility to meet mission requirements, and its military service components have been responsible for establishing and maintaining the locations.

DOD is likely to continue its use of forward-deployed locations in support of future U.S. defense strategy. In recent years, DOD has been undergoing a transformation to develop a defense strategy and force structure capable of meeting changing global threats. As part of its transformation, DOD has been reexamining overseas basing requirements to allow for greater U.S. military flexibility to combat conventional and asymmetric threats worldwide. U.S. military presence overseas has been converting from a posture established on familiar terrain to counter a known threat to one that is intended to be capable of projecting forces from strategic locations into relatively unknown areas in an uncertain threat environment.

DOD Fuel Demand and Delivery for Current Operations

In 2008, more than 68 million gallons of fuel, on average, were supplied by DOD each month to support U.S. forces in Iraq and Afghanistan. While DOD's weapon systems require large amounts of fuel—a B-52H, for example, burns approximately 3,500 gallons per flight hour—the department reports that the single largest battlefield fuel consumer is generators. Generators provide power for base support activities such as air conditioning/heating, lighting, refrigeration, and communications. A 2008 Defense Science Board Task Force report noted that Army generators alone consume about 26 million gallons of fuel annually during peacetime and 357 million gallons annually during wartime.¹⁰ Fuel is delivered to forward-deployed locations in Iraq via three main routes—from Kuwait in the south, Jordan in the west, and Turkey in the north—and to forward-deployed locations in Afghanistan via two main routes—from Central Asian states in the north and from Pakistan in the east. According to the Defense Energy Support Center, an organization within the Defense Logistics Agency that manages contracts for the department's fuel acquisitions and distribution, approximately 1.7 million gallons of jet fuel are delivered into Iraq and approximately 300,000 gallons of jet fuel are delivered into Afghanistan each day, in addition to other types of fuel, such as diesel, motor gasoline, and aviation gasoline. At one truck fill

¹⁰Defense Science Board Task Force on DOD Energy Strategy, *More Fight—Less Fuel* (February 2008). These figures were based on data and estimates collected by the DOD Project Manager-Mobile Electric Power office and the assumption that 50 percent of the total generator fleet would be utilized in wartime. The figures can vary greatly depending on the operational environment and other factors.

stand that we visited in Kuwait in June 2008, about 125 trucks, each holding 9,000 gallons of fuel, were loaded daily for delivery to forward-deployed locations in Kuwait and Iraq.

High fuel requirements on the battlefield can place a significant logistics burden on military forces, exposing supply convoys to risk. For example, long truck convoys moving fuel to forward-deployed locations have encountered enemy attacks, severe weather, traffic accidents, and pilferage. Army officials have estimated that about 70 percent of the tonnage required to position its forces for battle consists of fuel and water. Most fuel deliveries to forward-deployed locations in Afghanistan are made by commercial contractors, and there is no military-provided protection for the supply convoys other than the protection contractors provide themselves. DOD officials reported that in June 2008, for example, 44 trucks and 220,000 gallons of fuel were lost due to attacks or other events. While fuel delivery issues have not been as severe in Iraq recently, the U.S. military provides force protection to supply convoys in Iraq, increasing the logistics burden. Fuel delivery to locations outside of Iraq and Afghanistan may not be subject to battlefield conditions but is also logistically complex. For example, Camp Lemonier receives its fuel through the Djiboutian port. Fuel is loaded from the port into the storage tanks as it arrives, and trucks also make daily runs to the port to bring fuel to the camp.

Figure 1: Fuel Storage and Delivery for Military Operations



Sources: GAO (left) and Headquarters, Marine Corps (right).

DOD Mobility Fuel Costs

DOD reported that it consumed almost 4.8 billion gallons of mobility fuel and spent \$9.5 billion in fiscal year 2007, in addition to its costs for fuel consumed at fixed U.S. installations. While fuel costs represent less than 3 percent of DOD's total budget, they can have a significant impact on the department's operating costs. DOD has estimated that for every \$10 increase in the price of a barrel of oil, DOD's operating costs increase by approximately \$1.3 billion. DOD organizations pay a standard price for fuel that differs from the market price. The Office of Management and Budget (OMB) establishes for DOD the price the department will use when constructing its budget for upcoming fiscal years. DOD in turn uses OMB's price in establishing the standard price to be used for a barrel of fuel for budgeting purposes by DOD's customers, such as the military services. Because of the volatility of world petroleum prices, the standard price for a barrel of fuel included in the President's annual budget request for DOD may be lower or higher than the actual price established by the world market at any point in time after DOD's budget request is submitted to the Congress. The fiscal year 2009 President's budget assumed a standard fuel price of \$115.50 per barrel. At the time of this report, the price DOD charged its customers was \$104.58, or \$2.49 per gallon of jet fuel (JP8). In the past, DOD's standard fuel price was typically adjusted annually. However, with rising fuel costs in recent years, the price has been adjusted more frequently. Effective July 1, 2008, for example, DOD raised the standard fuel price per barrel from \$127.68 to \$170.94; and effective December 1, 2008, DOD lowered the standard fuel price per barrel from \$170.94 to \$104.58. Because the military services prepare their annual budgets based on the approved fuel price in the President's budget, market volatility resulting in out-of-cycle fuel price increases can be difficult for the services to absorb. DOD has received supplemental appropriations from the Congress in recent years to cover budget shortages associated with rising fuel prices.

Moreover, the fully burdened cost of fuel—that is, the total ownership cost of buying, moving, and protecting fuel in systems during combat—can be much greater than the cost of fuel itself. A 2008 Defense Science Board Task Force report noted that preliminary estimates by the OSD Program Analysis and Evaluation office and the Institute of Defense Analyses indicate that the fully burdened cost of a \$2.50 gallon of fuel could begin at about \$15, assuming no force protection requirements for supply convoys, and increases as the fuel moves further onto the battlefield. Fuel delivered in-flight has been estimated at about \$42 gallon, though the report notes that these figures are low. OSD has initiated a pilot program to determine the fully burdened cost of fuel for three mobile defense systems.

Concerns about future fuel costs, price volatility, and fuel availability have led the Air Force to undertake an effort to certify its entire aircraft fleet to run on a synthetic blend of alternative and jet fuels by early 2011. The Air Force has established a goal to acquire 50 percent of the aviation fuels it uses within the United States from domestic sources by 2016.

DOD Fuel Distribution Roles and Responsibilities

Fuel distribution is a complex process involving several DOD offices. Joint Publication 4-03 sets forth principles and establishes doctrine for bulk petroleum and water in support of U.S. military operations. The combatant commander has the predominant responsibility for fuel within a theater, and this responsibility is discharged by its Joint Petroleum Office. The Joint Petroleum Office is responsible for the overall planning of petroleum for operations, and it may establish sub-area petroleum offices as needed to support specific petroleum requirements. The Director, Defense Logistics Agency, as the integrated materiel manager for bulk petroleum, is responsible for meeting the petroleum support requirements of the combatant commands and military services. These functional responsibilities have been delegated to the Director, Defense Energy Support Center, which is responsible for procurement, transportation, ownership, accountability, budgeting, quality assurance, and quality surveillance. It also plans and budgets for the construction and repair of fuel storage and distribution facilities, monitors the petroleum market, and negotiates international agreements for energy commodities.

Each military service has responsibilities for providing petroleum support. The Army normally provides management of petroleum support to U.S. land-based forces of all DOD components. However, actual movement of bulk petroleum may include the use of commercial vehicles and associated infrastructure. The Air Force provides distribution of bulk petroleum products by air within a theater where immediate support is needed at remote locations. The Navy provides bulk petroleum products for U.S. sea- and land-based forces. The Marine Corps maintains a capability to provide bulk petroleum support to Marine Corps units. Within Central Command's area of responsibility, military units communicate their fuel requirements, which are based on historical usage and planned rotations, to the sub-area petroleum offices. The sub-area petroleum offices in turn provide these requirements to Central Command's Joint Petroleum Office for validation. Once the requirements are validated, the Defense Energy Support Center determines the most appropriate means to support the requirements and provides for the distribution of the fuel up to the "point of sale." The point of sale is the point at which the customer takes possession of the fuel. The Defense Energy Support Center owns

and tracks the fuel up until this point, at which time the fuel may be placed directly into a weapons system or battlefield storage unit or handed off to the customer to move to a forward-deployed location.

Congressional Requirements for Operational Energy

Section 902 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 requires that DOD establish a Director of Operational Energy Plans and Programs, who shall be appointed by the President and confirmed by the Senate, to provide leadership and facilitate communication and conduct oversight of operational energy plans and programs within the department and military services.¹¹ Among other responsibilities the director shall establish and maintain an operational energy strategy for the department; serve as the principal adviser to the Secretary of Defense and the Deputy Secretary of Defense on operational energy plans and programs; and consider operational energy demands in defense planning, requirements, and acquisition processes. In addition, the act requires that, within 90 days of the director's appointment, the secretaries of the military departments each designate a senior official to be responsible for operational energy plans and programs for his respective service. These senior service officials shall be responsible for coordinating with the director and implementing operational energy initiatives. The act further requires DOD to consider fuel logistics support requirements in the department's planning, requirements development, and acquisition processes—including the consideration of the fully burdened cost of fuel when analyzing fuel-consuming system alternatives.¹² The act also includes other energy requirements, including that DOD conduct a study on the feasibility of using solar and wind energy to provide electricity to deployed forces and the extent to which the use of such alternative energy sources could reduce the risk of casualties associated with convoys supplying fuel to forward-deployed locations.¹³ The Secretary of Defense, acting through the director, must also submit, on an annual basis, a report to the congressional defense committees on operational energy management and the implementation of the operational energy strategy.¹⁴

¹¹Pub. L. No. 110-417, Sec. 902 (a) (2008).

¹²Pub. L. No. 110-417, Sec. 332 (2008).

¹³Pub. L. No. 110-417, Sec. 333 (2008).

¹⁴Pub. L. No. 110-417, Sec. 331 (2008).

DOD Components Have Initiated Efforts to Reduce Fuel Demand at Forward-Deployed Locations

DOD components have efforts under way or planned for reducing fuel demand at forward-deployed locations. Many of these efforts are in a research and development phase, and the extent to which they will be fielded and under what time frame is uncertain. Notable efforts include the application of foam insulation to tent structures, the development of more fuel-efficient generators and environmental control units, and research on alternative and renewable energy sources for potential use at forward-deployed locations. In addition, during our visits to Kuwait and Djibouti, we found local camp efforts aimed at reducing fuel demand.

Power Surety Task Force Demonstrated Energy-Saving Benefits of Applying Foam Insulation to Tents

DOD is beginning to apply foam insulation on tents at some forward-deployed locations to reduce energy demand for powering these structures. In 2006, the DOD Power Surety Task Force was created in response to a joint urgent operational needs statement from a senior U.S. commander in Iraq calling for alternative energy sources to reduce the amount of fuel transported to forward-deployed locations for power generation. A mission of the task force is to identify and demonstrate emerging or commercial off-the-shelf technology that can reduce DOD's fuel demand. As one of several initiatives, the task force has demonstrated the benefits of applying foam insulation on temporary structures such as military tents. According to task force officials, tests show that the application of foam insulation reduces dust, heat, cold, noise, and air conditioning requirements, which in turn reduces generator-powered fuel demand.¹⁵ For example, the officials said that military tents insulated with foam at Fort Benning, Georgia, used half the climate control units and required 75 to 90 percent less power than non-insulated tents. (See fig. 2.)

¹⁵Army Corps of Engineers officials told us that there are some concerns about a lack of ventilation associated with the foam-insulated tents. In response, a task force official said that tests indicated that internal air quality standards could be met with the addition of a ventilation system that could be installed using commercially-available products and conventional tools.

Figure 2: Tent before Application of Foam Insulation and Tent after Application of Foam Insulation



Source: DOD Power Surety Task Force.

The Power Surety Task Force first demonstrated this technology at Fort Benning in January 2007, and later at some forward-deployed locations in Iraq, Afghanistan, Kuwait, and Djibouti. According to task force officials, based on the results of a recent demonstration of this technology, DOD decided to pursue a large-scale effort to apply foam insulation to temporary structures, such as military tents, in Iraq to reduce the number of generators needed to power those structures. According to a Central Command official, the tent foaming initiative could reduce energy consumption by approximately 50 percent, potentially reducing the number of convoys needed to supply fuel to locations in Iraq, although metrics had not yet been established to systemically measure efficiency.¹⁶ However, the contract for this initiative was terminated prior to completion, effective December 16, 2008. According to another Central Command official, the contract was terminated early due to contractor performance as well as support issues. At the time the contract was terminated, a DOD contractor noted that foam insulation had been applied to about 900 temporary structures (3.8 million square feet) at 10 forward-deployed locations in Iraq. According to a senior Army official, DOD has also issued a \$29 million contract to apply foam insulation to tent structures in Afghanistan, though he did not expect foaming to proceed until after the winter weather in Afghanistan subsided.

In addition to foam insulation, the DOD Power Surety Task Force is demonstrating other potential energy-saving technologies for use at forward-deployed locations. The Power Surety Task Force initiated a 3-

¹⁶According to a Central Command official, the 50 percent fuel savings estimate was based on feedback from military servicemembers.

year demonstration project—called the Net-Zero Plus Joint Capability Technology Demonstration—at the National Training Center in Fort Irwin, California, to demonstrate some of these technologies and solicit feedback from visiting military personnel. (App. III provides additional information on task force initiatives.)

Joint Program Office Is Developing More Fuel-Efficient Generators

Another DOD effort to reduce fuel demand is the development of new fuel-efficient generators and environmental control units. A DOD joint program organization, the Project Manager-Mobile Electric Power office, is responsible for providing a modernized standard family of mobile electric power generators to the military services. According to the office, many of DOD's generators have been in use for about three decades, exceeding their expected life cycle of 15 years. The office is developing a next generation of generators, called the Advanced Medium Mobile Power Sources, which employ advanced technologies to achieve greater fuel efficiency and other improvements over current military generators. When fully fielded, the new generators are expected to consume approximately 28 million gallons less fuel per year than the tactical quiet generators currently in use by the Army.¹⁷ According to a Project Manager-Mobile Electric Power official, DOD plans to begin procuring these new generators in 2010 at a weighted average cost of about \$18,000 per generator. In addition, officials said that the Project Manager-Mobile Electric Power office intends to replace its current environmental control units with improved environmental control units to provide cooling, heating, and dehumidifying for servicemembers and material systems. The improved units are expected to reduce energy consumption by up to 25 percent over current units. (See fig. 3.) An official told us that one version of the improved units is currently in low-rate initial production and a contract for another version is expected to be awarded in February 2009.

¹⁷The fuel savings estimate is based on tactical electric power operational requirements and takes into account the Army Force Generation model, which assumes that one-third of Army generators are used at wartime rates and two-thirds are used at peacetime rates in any given year.

Figure 3: Improved Environmental Control Unit



Source: DOD Project Manager-Mobile Electric Power.

The Project Manager-Mobile Electric Power office also has initiatives under way to improve the efficiency of power generation. For example, the office has fielded a more fuel-efficient method of generating power, called Central Power, at tactical operations centers (command posts) for the Army's 4th Infantry Division. Previously, power for these operations centers was provided by many small generator sets that had a large logistics footprint; required considerable fuel, maintenance, and personnel to operate; and were subject to disruptions in continuous power. The Central Power concept uses fewer, larger generators to provide independent "islands" of power generation, decreasing fuel consumption and the logistics footprint. According to Project-Manager Mobile Electric Power officials, Central Power saved the 4th Infantry Division roughly \$384,000 during its first year in use. The officials said that they have plans to field Central Power to all active Army components by the end of fiscal year 2009 but noted that the Army had not yet updated its equipment requirements list for units to include Central Power as a requirement.

Finally, the Project Manager-Mobile Electric Power office is pursuing a \$30 million, 6-year program to develop a future generation intelligent management grid architecture, called Hybrid Intelligent Power (HI-Power). HI-Power is intended to provide a flexible, grid-based architecture that enables "plug-and-play" power generation using a variety of power sources, including military and commercial generators, vehicles, and renewable energy sources such as wind and solar. According to the officials, HI-Power will automatically start and stop generators to match demand and store energy for transient power requirements. The intended benefits include reduced fuel consumption (by 17 to 40 percent depending

on the scenario), maintenance, personnel requirements, and power interruptions. The officials are planning for HI-Power to go into production during fiscal year 2013.

Military Services Are Researching Alternative and Renewable Energy Technologies

Several military services are exploring the use of alternative and renewable energy technologies to generate power at forward-deployed locations and reduce the demand for petroleum-based fuel. The Air Force's Air Force Research Laboratory created the Renewable Energy Tent City—a collection of various deployable shelters powered by solar and fuel cell generators situated at Tyndall Air Force Base, Florida. (See fig. 4.) The purpose of this research is to evaluate renewable energy technologies for use at forward-deployed locations, according to an Air Force Research Laboratory official. The official told us that the laboratory is assessing, among other technologies, a solar-integrated cover that it developed to generate power for small shelter systems using a form of solar cell technology. The Air Force is also engaged in other research and development projects involving the use of fuel cell, biofuel, and other alternative and renewable energy technologies.

Figure 4: Renewable Energy Tent City at Tyndall Air Force Base, Florida



Source: Air Force Research Laboratory.

The Marine Corps has several research initiatives under way to develop alternative energy systems for forward-deployed locations. For example, the Marine Corps Systems Command is working on the Deployable Renewable Energy Alternative Module. This module is intended to be towed by a vehicle and is designed to be used at forward-deployed locations to temporarily power radios or computers until fuel can be

resupplied to the locations by employing solar, wind turbine, battery, and generator technologies. (See fig. 5.) A Marine Corps Systems Command official told us that three prototypes have been designed using variations of these alternative technologies and that two have been tested. The official noted, however, that the technologies used for the modules have limitations. For example, vendors for this project developed solar cells that either required large surface areas—equal to the size of a tennis court—to recharge batteries or were too fragile for use in an austere environment. Furthermore, according to the official, the prototypes were not cost effective, since comparable diesel-powered generators with a 30-day supply of fuel could be procured and transported for considerably less. For these reasons, the modules are not likely to be deployed in the field, but the official said that lessons learned from this project could be used to inform the development of future energy systems.

Figure 5: Deployable Renewable Energy Alternative Module Prototype



Source: Marine Corps Systems Command.

The Army is also investigating ways of reducing fuel demand at forward-deployed locations through various research initiatives. For example, the Army Research Laboratory is working with universities and private sector firms to develop a processor that converts tires into energy and recyclable products that can be used at forward-deployed locations. (See fig. 6.) The scrap tire recycling process produces diesel, gas, carbon char, and steel—byproducts that can either be used to power generators, boilers, and other

items or recycled into products such as asphalt and paint. Project partners estimated that 2.7 million gallons of diesel fuel per year could be produced from a tire recycling facility operating at a forward-deployed location in Iraq, thereby reducing the number of trucks needed to deliver fuel. The fuel produced from this process is currently being tested to determine if it meets Army standards. In addition, the Army is providing support to the Project Manager-Mobile Electric Power office for the development of the Hi-Power program, and to the Power Surety Task Force for the development of a refinery system designed to convert trash into energy. Using a similar form of technology, the Army, working with the Defense Energy Support Center, intends to demonstrate six waste-to-fuel (diesel fuel) plants at six U.S. Army locations over the next year, according to a senior Army official.

Figure 6: Byproducts of Scrap Tire Recycling Process



Source: U.S. Army Corps of Engineers.

Specific Forward-Deployed Locations Have Efforts Under Way or Planned to Reduce Fuel Demand

During our visits to forward-deployed locations in Kuwait and Djibouti, we found some local efforts by camp officials to reduce fuel demand. In Kuwait, an official at Camp Arifjan shared plans to consolidate loads on small generators by creating groupings—or networks—of multiple generators, which could improve overall efficiency and reduce the number of generators that operate at most times of the year. Camp officials said

that they would like to build a centralized power plant for the location's communication complex by 2010. An Army official also told us that foam insulation was being used to cool tent structures in Kuwait, where outside temperatures can exceed 120 degrees Fahrenheit. According to the official, insulated facilities require fewer ventilation and air conditioning units to maintain cooler temperatures, thereby providing 20 to 40 percent in energy savings and reducing the wear and tear on the camp's generator fleet. As of June 2008, the Army was in the process of insulating tents with foam at Camp Buehring, Kuwait, and had plans to insulate tents at Camp Virginia, Kuwait. The official also told us that other alternatives to increase cooling efficiency, such as the use of special ceramic paints, were being explored.

During our visit to Camp Lemonier, Djibouti, Navy officials told us that they allowed the Power Surety Task Force to apply foam insulation on the tent exterior of the camp's gymnasium in August 2007. According to camp officials, the temperature inside the air-conditioned tent decreased from 95-100 degrees Fahrenheit to about 72 degrees after the foam insulation was applied. The officials also said that they were able to remove two of the five air conditioning units used to cool the facility, resulting in an estimated fuel savings of 40 percent. The officials were pleased with the reduced fuel demand and improved quality of life that were produced as a result of the demonstration. However, they noted that the disadvantages of the foam include more material to dispose of when the tent is disassembled and difficulty in moving or rearranging the tent after the foam was applied. In addition to the foaming, Camp Lemonier officials had also posted signs aimed at modifying the behavior of personnel to conserve energy. The signs included tips on taking shorter showers, using less air conditioning, and unplugging transformers when not in use. Camp officials had also developed an energy savings plan to reduce electrical consumption.

DOD Does Not Have an Effective Approach for Managing Fuel Demand at Forward-Deployed Locations

Although DOD is undertaking a number of initiatives focused on reducing fuel consumption, it lacks an effective approach for implementing fuel reduction initiatives and maintaining sustained attention to fuel demand management at its forward-deployed locations. DOD has stated that it needs to reduce its dependence on petroleum-based fuel and the logistics "footprint" of its military forces, as well as reduce operating costs associated with high fuel usage. In 2008, the Under Secretary of Defense for Acquisition, Technology and Logistics reported to Congress that fuel demand for operations in Iraq and Afghanistan is higher than any war in history and that protecting large fuel convoys imposes a high burden on

combat forces.¹⁸ The Under Secretary's report noted that reducing fuel demand would move the department toward a more efficient force structure by enabling more combat forces to be supported by fewer logistics assets, reducing operating costs, and mitigating the budget effects caused by fuel price volatility. However, we found that DOD's current approach to managing fuel demand at forward-deployed locations is not effective because it lacks (1) guidance directing locations to address fuel demand, (2) incentives and a viable funding mechanism to invest in fuel reduction initiatives, and (3) visibility and accountability within the chain of command for achieving fuel reduction. Until DOD addresses these shortcomings and makes fuel demand management a higher priority, DOD will face difficulty achieving its goals of reducing its reliance on petroleum-based fuel, the associated logistics burden, and fuel costs.

DOD Generally Lacks Guidance That Requires Attention to Fuel Demand

DOD generally lacks guidance that directs forward-deployed locations to manage and reduce fuel demand and thus cannot ensure that base commanders and their staffs will give sustained attention to this issue among their many other mission requirements. In contrast, DOD is driven to reduce energy consumption at its U.S. installations largely by federal mandates and DOD guidance. For example, the Energy Policy Act of 2005, Executive Order 13423, and the Energy Independence and Security Act of 2007 set energy reduction goals for federal buildings within the United States. Moreover, in November 2005, the Under Secretary of Defense for Acquisition, Technology and Logistics issued an instruction that provided guidance, assigned responsibilities, and prescribed procedures for energy management at its U.S. installations.¹⁹ The instruction addresses topics such as ensuring sufficient funds to meet energy goals, tracking and measuring progress and energy efficiency improvement, reporting energy use and accomplishments, and training facility managers on the energy efficient operation of facilities. Among other responsibilities, it requires the heads of DOD components to develop programs that result in facilities that are designed, constructed, operated, and maintained to maximize energy efficiency. However, DOD, Central Command, and military service officials we met with could not identify similar DOD policies, directives, or other documents that specifically require attention to fuel demand

¹⁸Department of Defense Report to Congress on Energy Efficiency in Weapons Platforms, Under Secretary of Defense for Acquisition, Technology and Logistics (Feb. 2008).

¹⁹DOD Instruction 4170.11, *Installation Energy Management*, Under Secretary of Defense for Acquisition, Technology and Logistics (Nov. 22, 2005).

management at forward-deployed locations, and we were told that it is not a key consideration. In responding to a draft of this report, DOD stated that the Army had issued an energy security implementation strategy in January 2009 that provides overarching guidance for reducing energy consumption at forward locations.²⁰ Our analysis of the Army's new strategy found that it emphasizes the need to reduce energy consumption, including at forward-deployed locations, but it does not provide specific guidance that directs forward-deployed locations to manage and reduce fuel demand. Instead, the strategy tasks offices of primary responsibility to develop and execute implementation plans that include activities to achieve the Army's energy security goals.

Construction

While some of DOD's combatant commands and military services have developed construction standards for forward-deployed locations, our analysis showed that this existing guidance is largely silent with regard to fuel demand management and energy efficiency. Pertinent guidance for Central Command, as well as Army guidance used by Central Command and European Command, revealed only one reference to energy efficiency—that is, semipermanent locations are to be designed and constructed with finishes, materials, and systems selected for moderate energy efficiency.²¹ According to the guidance, semipermanent construction standards will be considered for operations that are expected to last more than 2 years. Army construction guidance that Southern Command uses for its forward-deployed locations does not address fuel demand management or energy efficiency.²² A Southern Command official told us that the command is in the process of developing new guidance on construction standards similar to Central Command's guidance. Pacific Command officials told us that they were unaware of guidance on

²⁰Army Senior Energy Council and Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships, *Army Energy Security Implementation Strategy*, Department of the Army (Jan. 8, 2009).

²¹U.S. Central Command Regulation 451-1, *Construction and Base Camp Development in the USCENTCOM Area of Responsibility (AOR)*, "The Sand Book," Headquarters, United States Central Command (Dec. 17, 2007); United States Army Central Pamphlet 415-1, *Military Operations: Contingency Base Camp Handbook*, Headquarters, United States Army Central (Apr. 25, 2008); and Army in Europe Pamphlet 420-100, *Facilities Engineering: Standards for Forward Operating Sites*, Headquarters United States Army Europe and Seventh Army, United States Army Installation Management Command Europe Region (Apr. 21, 2008).

²²United States Army South Regulation 415-1, *Construction: Engineer Exercises in Latin America and the Caribbean*, Headquarters, U.S. Army South (June 2001).

constructing and maintaining forward-deployed locations within their area of responsibility.²³

Within Central Command, the temporary status of many forward-deployed locations has limited the emphasis on energy efficiency. Army Corps of Engineers officials said that the concern about maintaining a temporary presence, particularly in Iraq, limits the type of materials and equipment they are authorized to bring to forward-deployed locations and presents a challenge for creating energy efficiencies. The officials noted that, in practice, the Army—which has the most expertise in establishing forward-deployed locations in austere environments—does not typically use materials designed for operations lasting longer than 6 months at locations supporting current operations. Similarly, when we visited Camp Lemonier in June 2008, Navy officials told us that their camp’s “expeditionary” status hindered their ability to make construction upgrades to the camp, though we observed that Camp Lemonier had been under DOD’s control for about 6 years at that time.

In addition, the expedited nature of setting up forward-deployed locations limits emphasis on energy efficiency. For example, Army Corps of Engineers officials said that the approach to establishing forward-deployed locations in support of current military operations in Iraq and Afghanistan has been to start out with an austere set-up and build up the locations as needed. Because it is unknown how long a location might be in existence, the Army’s initial focus is on establishment, not on sustainment. In general, after the combatant commander determines a need for a forward-deployed location and the requirement is relayed to the Army, the Army moves quickly to deploy with prepackaged kits of equipment. According to the officials, energy efficiency is not a consideration at this point, and in fact, because the goal is to set up a location quickly, establishing a forward-deployed location can be energy intensive.

Though the process may vary depending on military service and the specific circumstances, including mission requirements, officials from the other military services described a similar process for how they establish forward-deployed locations. An Air Force official told us that because its service guidance does not explicitly address energy efficiency, it allows a

²³Army Corps of Engineers officials told us that Pacific Command consults portions of other combatant command guidance as needed.

certain amount of freedom and flexibility for the engineers, who “implicitly” incorporate energy efficiency into their planning.²⁴ A Marine Corps headquarters official told us that it is difficult to address fuel demand at forward-deployed locations because, as an expeditionary force, the Marine Corps does not expect to maintain a long-term presence at forward-deployed locations. Our review of the Navy’s guidance on advanced basing also revealed no mention of fuel demand management.²⁵ A Navy official involved with equipment logistics told us that his service has not been directed to examine energy efficiency while outfitting or procuring products for forward-deployed locations and that the Navy often resides at locations operated by other military services.

Maintenance

Similarly, we found a lack of attention to fuel demand in guidance, including an absence of fuel usage guidelines and metrics to evaluate progress of reduction efforts, as forward-deployed locations are sustained over time. The guidance officials identified for us generally does not address fuel demand management in sustaining locations even after they have been in existence for a certain period of time. For example, while the Air Force has issued guidance on vehicle management, which includes a goal to replace 30 percent or more of all applicable light duty vehicles with more fuel-efficient, low-speed vehicles by fiscal year 2010, Air Force officials did not provide us specific guidance on overall fuel demand management at forward-deployed locations.²⁶ The general lack of military service guidance on this issue makes it difficult to ensure the continuity of fuel reduction efforts at individual locations. For example, during our visit to Camp Arifjan, an official told us that the camp’s public works department was considering efficiency ratings, when possible, during the installation of heating and cooling systems in new or upgraded facilities in Kuwait, but he was unaware of DOD guidance requiring forward-deployed locations to address fuel demand. Moreover, officials we spoke with at Camp Lemonier said that they intended to implement a Navy instruction on energy management at their location even though it only applies to non-

²⁴Air Force Headquarters AFMC/A5C, *Agile Combat Support CONOPS* (Nov. 15, 2007), and Air Force Handbook 10-222, *Guide to Base Development*, Department of the Air Force (Feb. 1, 2006).

²⁵Department of the Navy Instruction 4040.39B, *Navy Advanced Base Functional Components (ABFC) Planning and Programming System*, Office of the Chief of Naval Operations (Aug. 23, 1996).

²⁶Air Force Instruction 23-302, *Material Management: Vehicle Management*, Secretary of the Air Force (Oct. 29, 2007).

nuclear ships, aircraft, vehicles, and shore installations.²⁷ While we found that both camps we visited were pursuing efforts to reduce fuel demand, the efforts were driven largely by individual officers with short tours of duty (typically 12 months or less). Without guidance and metrics that require forward-deployed locations to address fuel demand, DOD cannot ensure that fuel reduction actions taken at specific locations will be continued over time, as personnel and mission requirements change.

Procurement

In addition to construction and maintenance, the procurement of products for forward-deployed locations presents opportunities for DOD to consider making purchases that take into account fuel demand or energy efficiencies when practical. DOD's guidance for its U.S. or permanent installations requires the selection of energy-efficient products when they are life-cycle cost effective, and the Under Secretary of Defense for Acquisition, Technology and Logistics has established the DOD Green Procurement Program that strives to meet the requirements of federal green procurement preference programs. However, we did not find a similar emphasis on procuring energy-efficient products at DOD's forward-deployed locations. Moreover, while the Energy Policy Act of 2005 requires federal agencies to procure Energy Star products or Federal Energy Management Program-designated products, except in cases when they are not life-cycle cost effective or reasonably available to meet agency requirements, the law does not apply to any energy-consuming product or system designed or procured for combat or combat-related missions.²⁸ Officials from each of the military services indicated that there were unaware of efforts to procure energy-efficient products for forward-deployed locations. Instead, they told us that other factors, such as mission requirements, availability from local economies, or cost played a larger role in procurement decisions. Moreover, military services often gather together available equipment for forward-deployed locations from prepackaged sets, units, or the region, with little attention to energy efficiency. For example, Army Corps of Engineers officials told us that the Army often deploys with disparate generators that may be old and energy inefficient. While DOD guidance requires components to obtain approval to procure nonstandard generators, an official from DOD's Project Manager-Mobile Electric Power office admitted that it is difficult to

²⁷Department of the Navy Instruction 4100.5D, *Energy Management*, Office of the Chief of Naval Operations (Apr. 12, 1994).

²⁸Pub. L. No. 109-58, Sec. 104 (2005) (42 U.S.C. § 8259b (a)(5) (2008)).

enforce the requirement at forward-deployed locations.²⁹ He also noted that the military services' lists of required equipment may not contain enough power generation and distribution equipment to support current operations. Thus, we found that the military services turn to a variety of sources to find enough generators and other products to meet mission requirements, often without regard to energy efficiency.

There are some difficulties with procuring energy-efficient products for forward-deployed locations. From the Defense Logistics Agency's perspective, for example, these include limited product availability, logistics associated with transport to remote locations, and the compatibility of products with locally available energy sources, if used; or in the case of a solar-powered system, for instance, availability of on-site technical expertise for installing such a system. However, given DOD's high fuel demand for base support activities at its forward-deployed locations, without guidance in place to incorporate energy efficiency considerations into procurement decisions when practical, DOD may be missing opportunities to make significant reductions in demand without affecting operational capabilities.

Joint Living Standards

In a separate effort, the Joint Staff is in the process of developing common living standards (referred to as "joint standards of life support") for military servicemembers at forward-deployed locations, which could provide another opportunity to make decisions that take into account fuel demand considerations. Joint Staff officials said that the effort is intended to create a consistent level of habitability for servicemembers through the establishment of standard square footage requirements for living space, duration of showers, and so forth that would be applied at forward-deployed locations after 45 days of establishment. The officials described the effort as a long-term initiative intended to inform acquisitions. Once initial standards are approved by the department, a DOD memorandum would require the acquisition of common items, such as military tents, based on the standards.

At the time we completed our audit work, the Joint Staff had proposed an initial set of six standards—pertaining to field billeting, showers, laundry facilities, latrines, ice, and feeding—and had requested that a Senior Warfighting Forum be convened within DOD to review the initial

²⁹DOD Directive 4120.11, *Standardization of Mobile Electric Power (MEP) Generating Sources* (Apr. 13, 2004).

standards.³⁰ While officials told us that the Joint Staff has not included fuel demand considerations to date, we found that the types of standards the Joint Staff is developing have implications for fuel demand. For example, the duration of showers relates to how much fuel is required for hot water heaters. Moreover, the officials said that there may be opportunities in the future to develop standards for items such as military tents, generators, and other equipment used at forward-deployed locations. Thus, the effort provides an opportunity to integrate fuel demand considerations that could lead to long-term, departmentwide energy efficiencies.

DOD Lacks Incentives and a Viable Funding Mechanism for Fuel Reduction Projects

DOD has not established incentives or a viable funding mechanism for fuel reduction projects at its forward-deployed locations, which does not encourage commanders to identify fuel demand management as a priority.

DOD Has Not Established Fuel Reduction Incentives for Forward-Deployed Locations

DOD does not provide incentives to commanders to encourage fuel demand reduction at forward-deployed locations. By contrast, DOD emphasizes and encourages energy reduction efforts at its U.S. installations. A November 2005 instruction issued by the Under Secretary of Defense for Acquisition, Technology and Logistics requires the heads of DOD components to develop internal energy awareness programs to publicize energy conservation goals, disseminate information on energy matters and energy conservation techniques, emphasize energy conservation at all command levels and relate energy conservation to operational readiness, and promote energy efficiency awards and recognition through the use of incentives.³¹ The instruction also requires training and education for achieving and sustaining energy-efficient operations at the installation level through venues such as technical courses, seminars, conferences, software, videos, and certifications. The Navy has also established an energy conservation program, which has an award component, to encourage ships to reduce energy consumption. Awards are given quarterly to ships that use less than the Navy's

³⁰A Senior Warfighter Forum is a forum directed by the Joint Requirements Oversight Council, a four-star panel consisting of the Vice Chairman of the Joint Chiefs Staff and a four-star officer designated by each of the military services that makes recommendations to the Chairman, Joint Chiefs of Staff, on requirements, programs, and budgets. The Forum organizes, analyzes, prioritizes, and frames complex warfighter resource and requirements issues for the Joint Requirements Oversight Council's approval.

³¹DOD Instruction 4170.11.

established baseline amount of fuel, and fuel savings achieved during the quarter are reallocated to ships for the purchase of items such as paint, coveralls, and firefighting gear. We previously reported that the ship energy conservation program receives \$4 million in funding annually, and Navy officials told us that they achieved \$124.6 million in cost avoidance in fiscal year 2006. They said that some other benefits of the ship energy conservation program include more available steaming hours, additional training for ships, improved ship performance, reduced ship maintenance, and conservation of resources.

However, neither the Navy nor the other military services have established similar incentive programs for their forward-deployed locations. Instead, officials throughout the department consistently said that the amount of fuel forward-deployed locations consumed was related to mission requirements. We found that the lack of incentives tends to discourage commanders from pursuing projects that could reduce fuel demand. During our visit to Camp Lemonier, for example, we noted that officials had identified several projects that could reduce the camp's fuel usage, including a proposal to right-size air conditioning units in living units by replacing the current 2-ton units (24,000 BTUs) with 1-ton units and applying foam insulation to the rooftops of several buildings. However, camp officials questioned whether the upfront costs of these projects made them worth undertaking because there was no apparent "return on investment" for the camp, which would not see the associated savings to invest in other camp projects. Similarly, while officials at Camp Arifjan provided several examples of projects that could increase fuel efficiency at Kuwait locations, without incentives to pursue these projects, it is unclear whether they would take priority over other initiatives.

While DOD is driven to reduce energy consumption at its U.S. installations largely by federal mandates and DOD guidance, encouraging fuel demand reduction at forward-deployed locations will likely require a culture change for DOD. According to OSD and DOD Power Surety Task Force officials, the department has viewed fuel as a commodity necessary to meet its mission requirements because, historically, fuel has been inexpensive and free flowing for the department. However, from the perspective of the Power Surety Task Force, if commanders could reallocate funds saved through fuel reduction to other initiatives, DOD could be in a position to significantly reduce fuel demand at their locations.

Given DOD's view of the Global War on Terrorism as a "longer war," forward-deployed locations such as Camp Lemonier, Camp Arifjan, and

DOD Has Not Established a Viable Funding Mechanism for Fuel Reduction Projects

others could remain in existence for the foreseeable future and future conflicts will likely require the department to establish new locations. DOD recognizes the risks associated with its heavy fuel burden, but without incentives, commanding officials at DOD's forward-deployed locations are unlikely to identify fuel reduction as a priority in which to invest their resources.

DOD also has not developed a viable funding mechanism for fuel reduction projects at its forward-deployed locations. This makes it difficult for commanders to pursue projects that would reduce fuel demand, even though such projects could lower costs and, in some cases, risks associated with fuel delivery. A lack of a viable funding mechanism is an obstacle for locations supporting current operations, which are largely dependent on supplemental congressional appropriations. Since September 2001, a large portion of funding for military operations in support of the Global War on Terrorism has come through supplemental appropriations, which are requested by the department and approved by Congress separately from DOD's annual appropriation. At the time of our visit, Camp Lemonier relied completely on supplemental appropriations for its base support activities, and officials told us delays in receiving these funds presented challenges in covering existing costs, making it particularly difficult to pursue more expensive fuel demand reduction projects. Camp Arifjan was also heavily reliant on supplemental appropriations associated with the Global War on Terrorism. However, because about 40 percent of the camp was funded through a defense cooperative agreement with Kuwait, it also depended on the host country for resources.

We have previously reported that past DOD emergency funding requests have generally been used to support the initial or unexpected costs of contingency operations.³² Once a limited and partial projection of costs could be made, past administrations have generally requested further funding in DOD's base budget requests. We have encouraged DOD to include known or likely projected costs of ongoing operations related to the Global War on Terrorism with DOD's base budget requests. However, current administration policy is that the costs of ongoing military operations in support of the Global War on Terrorism, such as Operation

³²GAO, *Global War on Terrorism: DOD Needs to Take Action to Encourage Fiscal Discipline and Optimize the Use of Tools Intended to Improve GWOT Cost Reporting*, [GAO-08-68](#) (Washington, D.C.: Nov. 6, 2007).

Enduring Freedom and Operation Iraqi Freedom, should be requested as emergency funding. A senior Air Force official noted that, from his perspective, forward-deployed locations dependent on this type of emergency funding do not have to worry about reducing energy costs as DOD's permanent installations do because the commanders of forward-deployed locations know they will receive supplemental appropriations to cover their costs.

Our discussions with Army and DOD Power Surety Task Force officials about construction and maintenance of forward-deployed locations revealed that, from their perspectives, other funding restrictions also pose challenges in addressing fuel demands. DOD is appropriated funds for certain activities such as operation and maintenance, military construction, and other procurement. Operation and maintenance funds are used for minor construction spending, and such projects are limited to \$750,000 or less. In using operation and maintenance funds, the department and military services are also restricted by law from purchasing any investment item that has a unit cost greater than \$250,000.³³ The officials told us that, from their perspective, this restriction can result in energy inefficiencies. For example, the Army typically deploys with several smaller, less expensive and energy-inefficient generators. The officials said that, ideally, the Army would like to deploy with a larger, energy-efficient generator that exceeds the funding limit but could produce savings over the long term. The military services can seek approval for projects in excess of the limit, but projects compete with other priorities. An official with DOD's Power Surety Task Force told us that officials at Camp Victory in Iraq recently requested funding to consolidate generators, which would result in greater fuel efficiency, but were denied due to other priorities.

The department manages an Energy Conservation Investment Program that provides congressionally-appropriated military construction funds for projects that save energy or reduce defense energy costs for its existing installations but has no similar program specifically for forward-deployed locations. Through the program, the military services and defense agencies may submit projects for funding consideration based on a 10-year or less savings payback. Funds accrued through project savings may be used on projects that have experienced cost growth, for the design of energy conservation investment program projects, to supplement the funding of

³³10 U.S.C. § 2245a (2008).

future or prior-year program projects, or for additional program projects. In fiscal year 2007, the Energy Conservation Investment Program provided over \$54 million for 48 projects. Projects at all but five locations—Naval Support Activity Souda Bay, Greece; Kadena Air Base, Japan; Fort Buchanan, Puerto Rico; Ramstein Air Base, Germany; and a Defense Commissary project in Guam—were located within the United States.

DOD also uses energy savings performance contracts (ESPC) at several of its U.S. installations. Under an ESPC, DOD enters into a long-term contract (up to 25 years) with a private energy services company whereby the company makes energy-efficiency improvements financed from private funds. DOD then repays the company over a specified period of time until the improvements have been completely paid off. We previously reported that DOD had undertaken 153 ESPCs to finance about \$1.8 million in costs at about 100 military installations from fiscal years 1999 through 2003.³⁴ Moreover, the Army Corps of Engineers reported that from 1998 to March 2008, its Huntsville Center had awarded ESPC contracts that have resulted in \$420 million in contractor-financed infrastructure improvements on Army installations and a total projected energy cost savings to the government of \$100 million.

At the time of our review, the DOD Power Surety Task Force was investigating the feasibility of establishing an energy dividend reinvestment program to fund DOD energy projects across the department. According to the officials, the program would be structured similarly to an ESPC whereby an installation commander or program manager could submit a project for funding consideration. If, after analysis and review, funding was provided to pursue the project, the installation or program would then repay the program using savings achieved by the resulting energy efficiencies. While an initial briefing prepared for DOD's Energy Security Task Force and other department stakeholders noted all energy projects within DOD could be eligible under the program, including those at forward-deployed locations, the officials told us that this is unlikely because, like ESPCs, the program would rely on long-term contracts. DOD's forward-deployed locations might not be in existence for long periods of time, and therefore, the program might not be able to recoup savings for projects funded at these locations. Moreover, the officials expressed concern that if an installation or program incurred

³⁴GAO, *Energy Savings: Performance Contracts Offer Benefits, but Vigilance Is Needed to Protect Government Interests*, [GAO-05-340](#) (Washington D.C.: June 22, 2005).

higher energy costs than anticipated, it might not achieve its projected savings and might not be in a position to repay DOD.

DOD's Power Surety Task Force found that the source of funding for large fuel demand reduction projects, such as foaming tents at forward-deployed locations in Afghanistan, has been a challenge for the department, noting that energy efficiency does not fit neatly into the military services' budget processes. While the military services' budget processes allow them to budget for operation and maintenance costs, research and development efforts, and so forth, the processes prevent DOD from making quick, upfront investments in energy-efficiency projects. Conversely, the officials told us that DOD's budget process in effect discourages commanders from generating savings by reducing their future budgets—a limitation also cited by officials during our visit to Camp Lemonier. In 2003, our work highlighted a similar funding problem concerning corrosion mitigation projects.³⁵ We found that DOD and the military services gave corrosion mitigation projects, whose benefits may not be apparent for many years, a lower priority than other requirements that showed immediate results. In response to a subsequent Senate Armed Services Committee report, DOD established a specific, separate budget line for corrosion prevention activities to help ensure that sustained and adequate funding is available for the corrosion control projects that have the best potential to provide maximum benefit across the department.³⁶ This serves as one example for the department in considering how best to fund fuel reduction projects at forward-deployed locations. Without establishing a viable funding mechanism for these projects, DOD is not well-positioned to achieve fuel savings at its forward-deployed locations.

DOD Lacks Visibility and Accountability over Fuel Demand Reduction

While DOD and the military services have efforts under way to reduce fuel demand at forward-deployed locations, DOD's current organizational framework does not provide the department visibility or accountability over fuel demand issues at its forward-deployed locations. We found that fuel reduction efforts are not consistently shared among locations, military services, or across the department and that there is no one office or official specifically responsible for fuel demand management at forward-deployed locations.

³⁵GAO, *Defense Management: Opportunities to Reduce Corrosion Costs and Increase Readiness*, GAO-03-753 (Washington, D.C.: July 7, 2003).

³⁶S. Rep. No. 108-260, at 319 (2004).

Officials we spoke with from each of the military services told us that fuel demand reduction practices at forward-deployed locations were not consistently shared. For example, Army Corps of Engineers officials said that no formal system is in place specifically designed to share fuel demand reduction practices. Informal conversations occur, though on an ad hoc basis. They acknowledged that forward-deployed locations often pursue different initiatives; and the department, other military services, or other Army forward-deployed locations are often unaware of these different initiatives. Air Force officials also said that their service does not have visibility over fuel demand reduction practices that may occur at forward-deployed locations, noting that with joint operations and Air Force forces embedded with the Army, fuel consumption is not systemically recorded. Officials from the Navy and Marine Corps were also unable to provide examples where fuel demand reduction practices were shared across locations.

Moreover, while DOD guidance sets forth principles and establishes doctrine for bulk petroleum and water in support of military operations, it does not designate any DOD office or official as being responsible for fuel demand management at forward-deployed locations.³⁷ As table 1 shows, several different offices have responsibility for petroleum management, but none is specifically accountable for fuel demand management at forward-deployed locations.

³⁷Joint Chiefs of Staff, Joint Pub. 4-03, *Joint Bulk Petroleum and Water Doctrine* (May 23, 2003).

Table 1: Responsibilities for Bulk Petroleum in Support of Military Operations

Office	Responsibilities
Under Secretary of Defense for Acquisition, Technology and Logistics	Establish policies for management of bulk petroleum stocks and facilities and provide guidance to other DOD agencies, the Joint Staff, and the military services.
Deputy Under Secretary of Defense (Logistics and Materiel Readiness)	Serve as the central administrator for energy management and has integrated materiel management oversight responsibility for fuel products. ^a
Under Secretary of Defense (Comptroller)	In coordination with the Under Secretary of Defense for Acquisition, Technology and Logistics, establish financial policies and guidance for management of bulk petroleum products.
Chairman, Joint Chiefs of Staff	Primarily focuses on wartime support; coordinate with DOD, the military services, and the combatant commands to resolve petroleum issues.
Joint Staff J-4	Act as primary agent of the Chairman of the Joint Chiefs of Staff for all bulk petroleum matters.
Commander, U.S. Transportation Command	Develop long-range plans for petroleum support of the inter-theater mission and contingency operations worldwide.
Combatant Commanders	Ensure fuel support is provided to combat forces to accomplish those missions assigned by the President and the Secretary of Defense.
Director, Defense Logistics Agency	Meet the petroleum support requirements of the combatant commands and the military services.
Director, Defense Energy Support Center	Carry out functional responsibilities of the Director, Defense Logistics Agency to include procurement, ownership, quality surveillance, accountability, budgeting, and non-tactical distribution of bulk petroleum stocks to the point-of-sale.
Military Services	Provide petroleum support to its service and other services; is responsible for further distribution and management of fuel once it has been delivered to the service.

Source: Joint Chiefs of Staff Joint Publication 4-03.

^a We previously reported that although this office plays an active role in maintaining DOD policy on energy supply issues and participates in other department-level fuel-related activities, its primary focus has not been on departmentwide fuel reduction efforts.

In addition, we could not identify anyone who is specifically accountable for fuel demand management through our interviews with various DOD and military service offices. While the DOD Power Surety Task Force has been serving as a liaison on energy issues between the combatant commands and military services, its temporary status and resources limit its effectiveness. Moreover, because the Power Surety Task Force staff is made up of contactors, OSD recognizes that the Power Surety Task Force cannot represent the department. Defense Energy Support Center officials told us that DOD needs to create an energy office to oversee fuel demand reduction efforts and develop policy for the department.

The Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 requires DOD to establish a Director of Operational Energy Plans and Programs, an operational energy strategy for DOD, and military department-level energy officials. The military departments have

established senior energy officials, but DOD has not yet established a director or strategy for operational energy. In meeting these requirements, DOD has an opportunity to improve visibility and accountability by assigning responsibility and emphasize fuel demand management at forward-deployed locations at both the department and military service levels. An OSD official involved with the DOD Energy Security Task Force noted that operational energy options should be a high priority of the new director. Without establishing visibility and accountability over fuel demand management at forward-deployed locations, DOD is not well positioned to address the shortcomings we have identified in this report—including the lack of fuel reduction guidance, incentives, and a viable funding mechanism for initiatives to decrease demand. Thus, DOD cannot be assured that good fuel reduction practices are identified, shared, prioritized, resourced, implemented, and institutionalized across locations in order to reduce the costs and risks associated with high fuel demand.

Conclusions

DOD faces high costs, operational vulnerabilities, and logistical burdens in sustaining forward-deployed locations that depend heavily on fuel-based generators. Moreover, current operations have resulted in DOD maintaining some forward-deployed locations for longer than initially anticipated and generally without regard to fuel demand. While DOD's future operations may be unknown, the department's goals to reduce its reliance on petroleum-based fuel and minimize its logistics footprint—coupled with its reexamination of its overseas posture to better respond to the changing threat environment—underscore the importance of increasing attention on fuel demand management at overseas locations where U.S. forces are stationed. Although base commanders must place their highest priority on meeting mission requirements and it may not be practical for DOD to decrease fuel usage at every forward-deployed location, particularly at those that might not be in existence for very long, fuel demand is likely to remain high until the department gives systematic consideration to incorporating fuel demand in construction, maintenance, procurement, and other policy decisions for forward-deployed locations. In addition, the department will not be in a position to effectively identify, share, prioritize, resource, implement, or institutionalize good fuel reduction practices across locations that may exist for longer periods of time. By placing a higher priority on fuel reduction at forward-deployed locations and developing a comprehensive and coordinated approach to managing fuel demand, one that includes specific guidelines, incentives, a viable funding mechanism, visibility, and accountability, DOD would be more likely to achieve its goals of reducing its reliance on petroleum-based fuel, the vulnerabilities and logistics burden associated with transporting

large amounts of fuel to forward-deployed locations, and operational costs.

Recommendations for Executive Action

To establish an effective approach to managing fuel demand that would facilitate the widespread implementation of fuel reduction initiatives and sustained attention to fuel demand issues at its forward-deployed locations, we recommend that the Secretary of Defense take the following five actions.

1. Direct the combatant commanders, in consultation with their military service component commands, to establish requirements for managing fuel demand at forward-deployed locations within their areas of responsibility and provide specific guidelines as appropriate. Officials may wish to consider identifying a triggering mechanism in the guidance, such as a specific length of time after a location is established, when fuel demand management should become a consideration in forward-deployed location sustainability. In establishing requirements, the combatant commanders should coordinate their efforts with the new DOD Director of Operational Energy Plans and Programs to ensure departmentwide communication and consistency, where appropriate.
2. Direct the Secretaries of the Army, the Navy, the Air Force, and the Commandant of the Marine Corps to develop guidance that implements combatant command requirements for managing fuel demand at forward-deployed locations. The guidance should include specific guidelines that address energy-efficiency considerations in base construction, maintenance, procurement, and policies regarding fuel usage at a location. In establishing guidance, the military services should coordinate their efforts with the new DOD Director of Operational Energy Plans and Programs to ensure departmentwide communication and consistency, where appropriate.
3. Direct the Chairman, Joint Chiefs of Staff, to require that fuel demand considerations be incorporated into the Joint Staff's initiative to develop joint standards of life support at DOD's forward-deployed locations.
4. Designate the new, congressionally-mandated DOD Director of Operational Energy Plans and Programs as the department's lead proponent of fuel demand management at forward-deployed locations, and through this designation, require that the director develop action plans as part of the congressionally-mandated DOD energy strategy.

Specifically, the strategy should incorporate the department's action plans for

- facilitating departmentwide communication and consistency, when appropriate, in the development or revision of combatant command and military service guidance that establishes requirements and provides guidelines for managing fuel demand at forward-deployed locations;
 - establishing incentives for commanders of forward-deployed locations to promote fuel demand reduction at their locations, as well as identifying a viable funding mechanism for the department and commanders of forward-deployed locations to pursue fuel reduction initiatives;
 - establishing visibility over fuel demand management at forward-deployed locations, including plans for sharing good fuel reduction practices and solutions to identified challenges; and
 - establishing accountability for fuel demand management at appropriate levels across the department.
5. Direct the Departments of the Army, Navy, and Air Force to assign their senior energy officials, among their other duties, responsibility for overseeing fuel demand management at forward-deployed locations operated by their military department components. In carrying out this responsibility, the officials should identify and promote sharing of good fuel reduction practices and solutions to identified fuel demand challenges at their component's forward-deployed locations and communicate those practices and solutions to the DOD Director of Operational Energy Plans and Programs for potential use across the department.

Agency Comments and Our Evaluation

In its written comments on a draft of this report, DOD generally concurred with all of our recommendations. Technical comments were provided separately and incorporated as appropriate. The department's written comments are reprinted in appendix IV.

In response to our recommendation that DOD direct the combatant commanders to establish requirements for managing fuel demand at forward-deployed locations in coordination with the new DOD Director of Operational Energy Plans and Programs, DOD partially concurred, stating that it believes the combatant commanders must be the decision authorities for when reduction efforts should begin to be tracked and what conservation measures are employed, in order to avoid distraction from

tactical operations. While we agree that the combatant commanders should be responsible for establishing requirements for managing fuel demand at their forward-deployed locations, it is important that this effort be coordinated with the new DOD director of operational energy as well as with the service component commands. Our report recommends that DOD designate the new director of operational energy as the lead proponent of fuel demand management at forward-deployed locations, and through this designation, facilitate departmentwide communication and consistency of requirements and guidelines for managing fuel demand, as well as establish visibility and accountability for fuel demand management. DOD generally concurred with our recommendations pertaining to the new director's responsibilities. In order to effectively carry out these responsibilities, attain visibility over fuel demand issues across the department, and serve as the DOD official accountable for such issues, the director of operational energy should be consulted by the combatant commanders in establishing fuel demand management requirements to ensure departmentwide communication and consistency occurs where appropriate.

DOD concurred with our recommendation that the secretaries of the military services develop guidance that implements the combatant command requirements for managing fuel demand and include specific guidelines that address energy efficiency considerations. In its response, the department stated that guidelines on policy will be general in nature and allow combatant commands flexibility. While we believe that forward-deployed locations within different regions could require different guidelines, our audit work revealed that current guidance for Central Command and Army guidance used in Central Command and European Command contain only a general reference to energy efficiency—that semipermanent locations are to be designed and constructed with finishes, materials, and systems selected for moderate energy efficiency—and that this guidance is not effective in implementing fuel demand considerations at forward-deployed locations. Our report concludes that fuel demand is likely to remain high until DOD gives systematic consideration to incorporating fuel demand management into construction, maintenance, procurement, and other policy decisions for forward-deployed locations. Therefore, we continue to believe that the military service guidelines on fuel demand management should provide enough specificity to appropriately address these issues so that DOD can achieve its goals of reducing its fuel demand, logistics burden, and operational costs.

As noted, DOD generally concurred with our recommendations on the responsibilities of the new director of operational energy. However, regarding the need to establish a viable funding mechanism for fuel

reduction projects at forward-deployed locations, the department stated that it is not convinced that financial incentives represent the best fuel reduction strategy for forward-deployed locations. We recognize that DOD has various options for providing incentives to commanders at forward-deployed locations to reduce fuel demand but continue to believe that, based on our audit work, the availability of funding for such projects is a concern that needs to be addressed.

DOD concurred with our other recommendations that the Joint Staff incorporate fuel demand considerations into its initiative to develop joint standards for life support at DOD's forward-deployed locations and that the military department senior operational energy officials be assigned responsibility for oversight of fuel demand management at forward-deployed locations operated by their military service component commands.

As we agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 30 days from the date of this letter. At that time, we will send copies of this report to the Secretary of Defense; the Deputy Secretary of Defense; the Chairman of the Joint Chiefs of Staff; the Under Secretary of Defense for Acquisition, Technology and Logistics; the Secretaries of the Army, Navy, and Air Force; and the Commandant of the Marine Corps. This report will also be available at no charge on the GAO Web site at <http://www.gao.gov>.

Should you or your staff have any questions concerning this report, please contact me at (202) 512-8365 or solisw@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to the report are listed in appendix V.

A handwritten signature in black ink, appearing to read 'W. Solis', with a long horizontal flourish extending to the right.

William M. Solis
Director
Defense Capabilities and Management

Appendix I: Fuel Demand at Selected DOD Forward-Deployed Locations during June 2008

This appendix illustrates the Department of Defense's (DOD) fuel demand at selected forward-deployed locations for a 1-month period during 2008. We obtained and analyzed fuel receipts and consumption information, by fuel type (jet fuel, diesel, and mobility gasoline), for each day in June 2008 from five forward-deployed locations that were in Central Command's area of responsibility and heavily reliant on fuel-consuming generators for power. The locations, which were selected in consultation with Central Command officials, were:

- Camp Lemonier, Djibouti,
- Qayyarah West (Q-West) Air Base, Iraq,
- Camp Arifjan, Kuwait,
- Contingency Operating Base (COB) Adder, Iraq, and
- Bagram Air Field, Afghanistan

The information presents a snapshot in time and cannot be generalized to other time periods or forward-deployed locations. One limitation of the data involves how locations classified fuel consumed for either base support activities (defined as power, heating/cooling, facilities, communications) or air and ground operations (the later defined as vehicles). Although we provided the locations with examples of base support activities and air and ground operations, these categories can encompass a wide range of interrelated or overlapping activities. Therefore, we deferred to the discretion of location officials in how they classified their fuel use activities. Another limitation involves how the data were collected. Data collection procedures and systems varied by military service component and location; however, we found that each location used a quality assurance process to ensure that the data were accurate and complete. Therefore, we concluded that the data were sufficiently reliable for descriptive purposes. For more information on our scope and methodology, see appendix II.

Selected Forward-Deployed Locations Reported Consuming Large Amounts of Fuel for Base Support Activities and Air and Ground Operations in June 2008

The locations we reviewed reported consuming a total of approximately 11.67 million gallons during June 2008 for base support activities, including power for heating/cooling units, machinery, and lighting; and for air and ground operations, including aircraft, armored vehicles, and other forms of transport. Table 2 and figure 7 summarize these fuel consumption data.

**Appendix I: Fuel Demand at Selected DOD
Forward-Deployed Locations during June
2008**

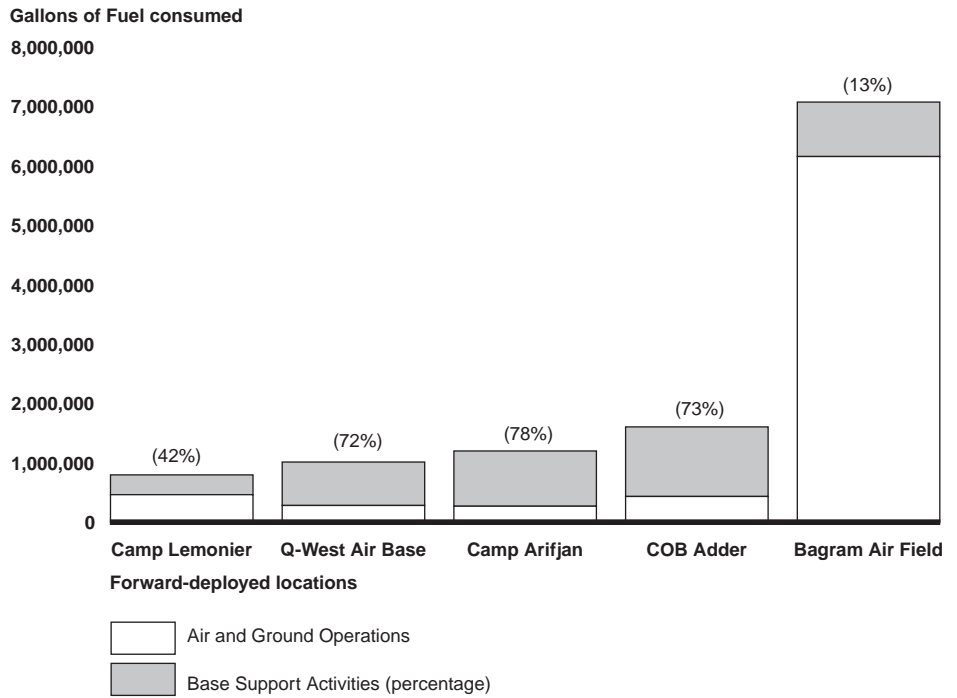
Table 2: Fuel Consumption Reported by Selected Forward-Deployed Locations for June 2008

Location	Gallons of fuel consumed		
	Fuel for base support activities	Fuel for air and ground operations	Total fuel consumed
Camp Lemonier	333,191	460,555	793,746
Q-West Air Base	731,449	278,769	1,010,218
Camp Arifjan	930,472	266,154	1,196,626
COB Adder	1,171,618	430,395	1,602,013
Bagram Air Field	916,911	6,155,225	7,072,136
Total	4,083,641	7,591,098	11,674,739

Source: GAO analysis of DOD data.

Note: Bagram Air Field and Camp Lemonier reported fuel for aerospace ground equipment (equipment used in servicing, handling, and maintaining weapon systems) as fuel for air or ground operations, while Q-West reported fuel for aerospace ground equipment as fuel for base support activities. The other two locations, COB Adder and Camp Arifjan, do not have flying missions.

Figure 7: Proportion of Fuel Consumption Reported for Base Support Activities and for Air and Ground Operations by Selected Forward-Deployed Locations for June 2008



Source: GAO analysis of DOD data.

Note: Bagram Air Field and Camp Lemonnier reported fuel for aerospace ground equipment as fuel for air or ground operations, while Q-West reported fuel for aerospace ground equipment as fuel for base support activities.

As shown in table 2, of the overall amount of fuel consumed by the five locations during this 1-month period, more than 4 million gallons (35 percent) were consumed for base support activities. In comparison, the same amount of fuel could be used to fill 71 Boeing 747 jet airliners.¹ Base support activities accounted for over 70 percent of total fuel consumption for three of the locations in our review—Q-West Air Base, Camp Arifjan, and COB Adder. COB Adder consumed the largest amount of fuel for base support activities in June at 1.17 million gallons. Bagram Air Field reported that 13 percent of its fuel consumption in this month was for base support activities—a proportion that was lower than that of the other bases.

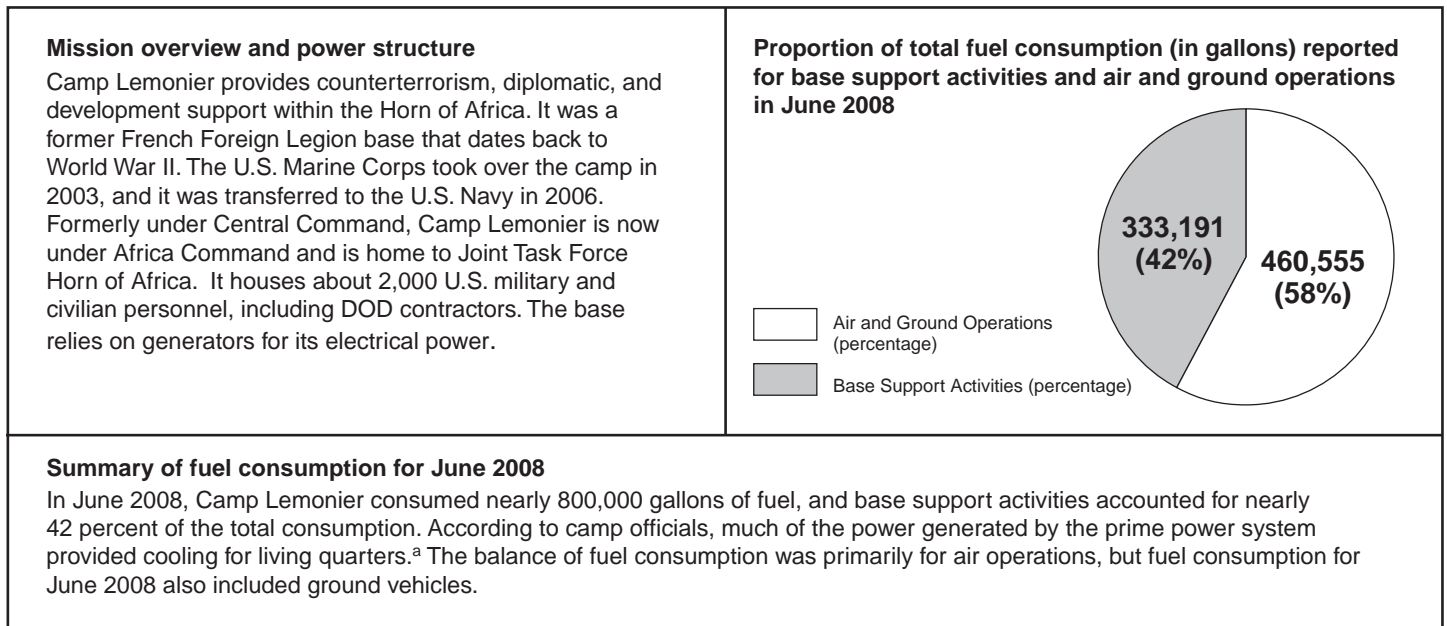
¹Calculated using specifications from the Boeing Company’s web site.

However, the 6.16 million gallons that Bagram Air Field consumed for air and ground operations in June was more than four times the amount of fuel consumed for air and ground operations by the other four locations combined.

Fuel Demand Profiles of Individual Locations

Figures 8 through 12 provide a brief description of the mission, power structure, and June 2008 fuel demand for each of the five forward-deployed locations. Each profile also includes a chart showing the proportion of total fuel consumed for base support activities and air and ground operations.

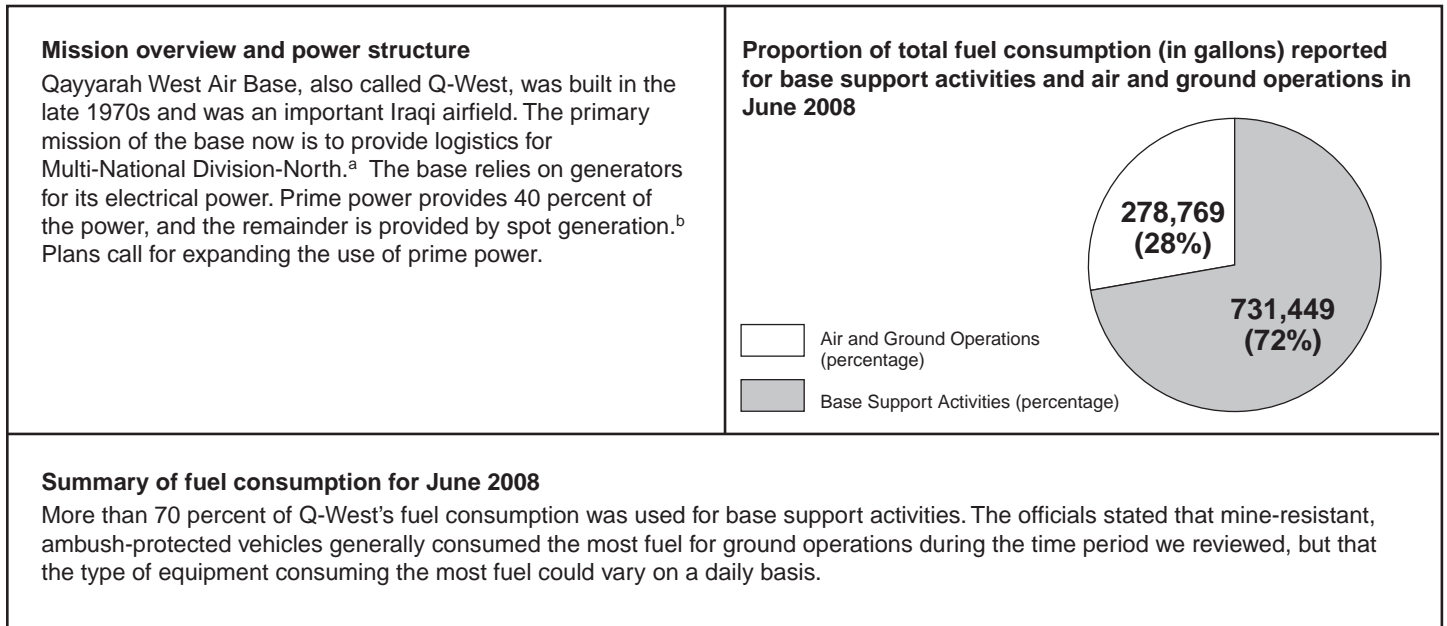
Figure 8: Camp Lemonier



Source: GAO analysis of DOD data (pie chart).

^aAccording to a DOD Project Manager-Mobile Electric Power official, prime power refers to mobile, but large, generators that operate off of higher voltages than spot generators and provide large amounts of continuous power.

Figure 9: Q-West Air Base



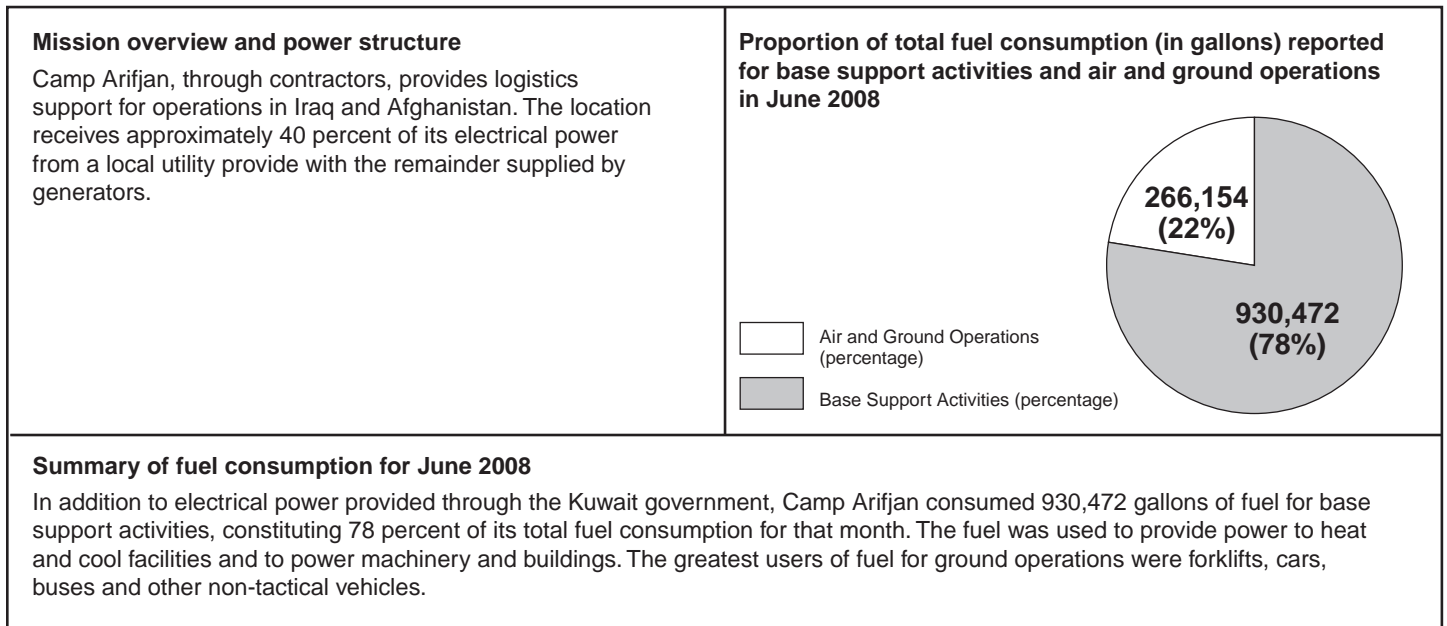
Source: GAO analysis of DOD data (pie chart).

^aIraq is divided into major areas of responsibility referred to as major subordinate commands. These include (1) Multinational Division-Baghdad, (2) Multinational Division-North, (3) Multinational Force-West, (4) Multinational Division-Central South, and (5) Multinational Division-Southeast.

^bSpot generation, or distributed power, generally refers to generators that operate at lower voltages and produce less power than prime power units.

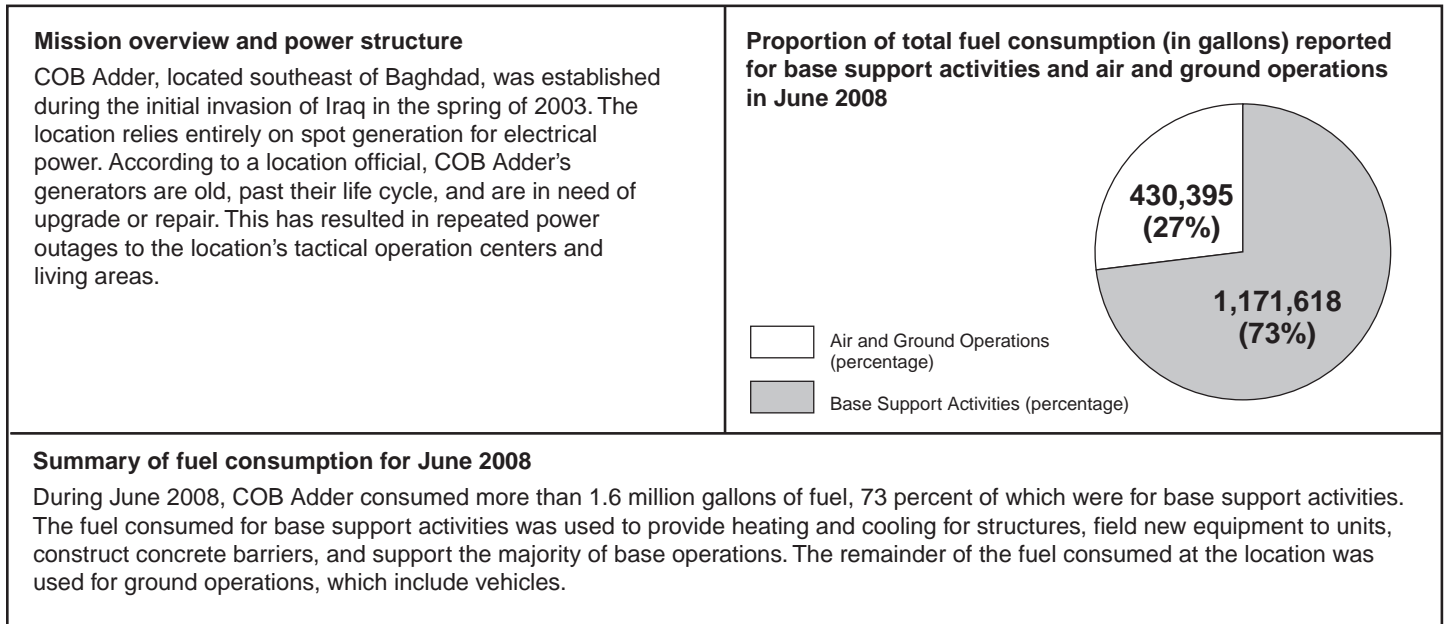
Appendix I: Fuel Demand at Selected DOD Forward-Deployed Locations during June 2008

Figure 10: Camp Arifjan



Source: GAO analysis of DOD data (pie chart).

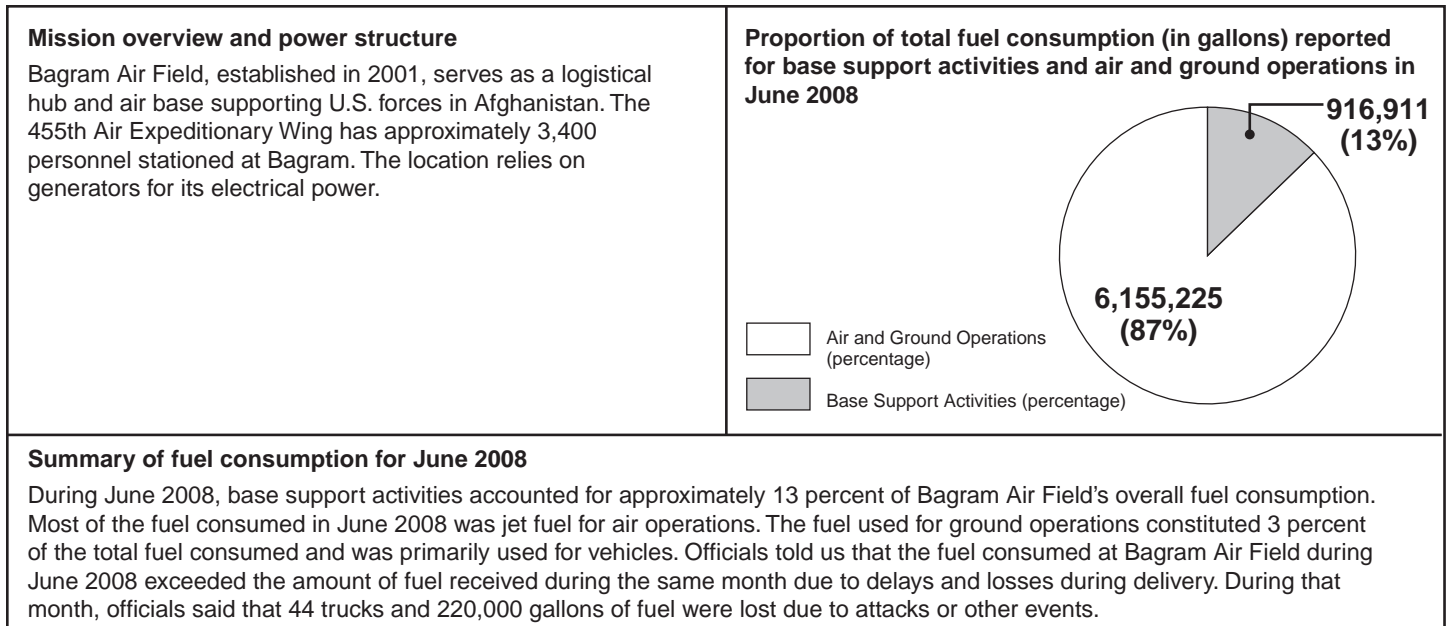
Figure 11: Contingency Operating Base Adder



Source: GAO analysis of DOD data (pie chart).

Appendix I: Fuel Demand at Selected DOD Forward-Deployed Locations during June 2008

Figure 12: Bagram Air Field



Source: GAO analysis of DOD data (pie chart).

Appendix II: Scope and Methodology

We conducted our work at the Office of the Secretary of Defense (OSD); the Joint Staff; the headquarters and select components of the Army, Air Force, Navy, and Marine Corps; the Defense Logistics Agency, including the Defense Energy Support Center; and the Power Surety Task Force.

To review DOD efforts to reduce fuel demand at forward-deployed locations, we reviewed DOD component documents describing efforts and met with DOD and military service officials to identify and discuss the intent, scope, and status of these efforts. Our review focused on forward-deployed locations—installations or base camps situated outside of the United States that support current operations—that rely primarily on fuel-based generators, as opposed to local power grids.¹ We supplemented our analysis with visits to Camp Arifjan, Kuwait, and Camp Lemonier, Djibouti, where we observed efforts made at the locations and discussed them with cognizant officials. After consultation with Central Command officials, we selected and visited these two forward-deployed locations to gain a firsthand understanding of fuel demand issues at these locations. We chose to visit these locations because servicemembers at each location relied heavily on fuel-based generators, as opposed to local power grids, to carry out very different missions—the former directly supported operations in Iraq while the latter provided diplomatic, development, and counterterrorism support within the Horn of Africa.² We also chose these locations because officials told us that the camps were pursuing fuel demand reduction efforts; for example, Camp Lemonier had applied foam insulation to a facility to reduce fuel demand. We treated these two locations as illustrative case studies in our report and information obtained from these locations is not generalizable to other forward-deployed locations.

To review DOD's approach to managing fuel demand at forward-deployed locations, we analyzed department documents and held discussions with DOD and military service officials to gain their perspectives on issues including forward-deployed location construction and maintenance; procurement; funding procedures; and applicable DOD guidance and laws related to energy reduction, procurement, and military construction. To provide context for understanding the challenges associated with

¹We excluded Navy vessels from the scope of our review.

²At the time of our visit in June 2008, both camps were under Central Command's area of responsibility. On October 1, 2008, DOD established Africa Command and transferred Camp Lemonier under this command.

managing fuel demand at forward-deployed locations, we obtained information on fuel distribution and delivery processes and challenges in Iraq, Afghanistan, and for the two forward-deployed locations we visited. For comparison purposes, we reviewed policies and programs related to energy awareness and reduction for DOD's permanent or U.S. facilities. In identifying opportunities for DOD to increase visibility and accountability of fuel demand management at its forward-deployed locations, we reviewed sections of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 that require DOD to, among other things, establish a Director of Operational Energy Plans and Programs and an operational energy strategy and that require the secretaries of the military departments to designate senior officials for operational energy.

To provide information on DOD's fuel demand at selected forward-deployed locations (app. I), we asked Central Command officials to identify and collect fuel receipts and consumption data from June 1 through 30, 2008, at several forward-deployed locations in Iraq and in Afghanistan that rely heavily on generators, as opposed to commercial power supplied by the host country. The data collected only represent a snapshot in time of fuel demand at selected locations and cannot be generalized to other time periods or other forward-deployed locations. In total, Central Command collected fuel receipts and consumption data for us on two locations in Iraq (Q-West and Contingency Operating Base Adder) and one location in Afghanistan (Bagram Air Field). In addition, we collected fuel receipts and consumption data for the same time period at Camp Arifjan, Kuwait, and Camp Lemonier, Djibouti, the two locations from our case-study analysis. The missions of these locations ranged from providing logistics support to U.S. forces to supporting development and diplomacy within the region. Central Command officials told us that different military services and locations have different methods for collecting and reporting data. Therefore, to attempt to collect as similar data as possible among the various locations, we agreed that Central Command would develop a standard data collection spreadsheet for the locations to record the following information by day in June 2008:

- the quantity of fuel in gallons received by fuel type—JP8 jet fuel, diesel, or mobility gasoline,
- the quantity of fuel in gallons consumed for base support (defined as power, heating/cooling, facilities, or communications),
- the quantity of fuel in gallons consumed for air mobility,
- the quantity of fuel in gallons consumed for ground mobility (vehicles),
- the largest consumer of base support fuel (for example, heating/cooling) and

- the largest consumer of ground mobility fuel by day (for example, Mine Resistant Ambush Protected vehicle).

This spreadsheet was used to collect fuel receipt and consumption data from all five of the locations we reviewed. We agreed with Central Command officials to use this spreadsheet to increase the likelihood that the locations would categorize fuel consumed for base support activities and ground and air operations similarly; however, some of the locations categorized fuel used for aerospace ground equipment differently.³ In an attempt to reconcile these differences, we subsequently requested that officials provide us separate data pertaining to aerospace ground equipment, but officials stated that the data were not collected in a way that could enable them to do so. Therefore, in appendix I we have noted this difference in the data illustrating fuel used by the locations for base support and ground and air operations. To determine whether the data were reliable and valid, we sent follow-up questionnaires to each of the locations reviewed, asking how the locations recorded and maintained the data provided to us and what quality assurance process they used to ensure that the data were accurate and complete. Although data collection procedures and systems varied by military service component and location, we found that the data underwent a quality review. Therefore, we concluded that the data were sufficiently reliable for descriptive purposes.

We conducted our review from March 2008 through February 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

³Aerospace ground equipment refers to equipment used in servicing, handling, and maintaining weapon systems. Bagram Air Field and Camp Lemonier reported fuel for aerospace ground equipment as fuel consumed for air or ground operations, while Q-West reported fuel for aerospace ground equipment as fuel consumed for base support activities. The other two locations, COB Adder and Camp Arifjan, do not have flying missions.

Appendix III: Selected Initiatives of the DOD Power Surety Task Force to Reduce Fuel Demand at Forward-Deployed Locations

This appendix provides an overview of selected initiatives of the DOD Power Surety Task Force that are aimed at reducing fuel demand at forward-deployed locations. It also provides information on the status of each initiative at the time we conducted our review.

Figure 13: Eskimo Spray Foam Insulation



Description:

Application of foam insulation on tent structures to decrease fuel demand. According to Power Surety Task Force officials, Eskimo has demonstrated a 40 to 75 percent reduction in power use for heating, ventilation, and air conditioning and is expected to recoup costs within 4 months of deployment.

Status:

Has been tested in four countries. Currently being applied to tents in Iraq. DOD plans to apply foam on tents in Afghanistan and Kuwait.

Source: GAO (photograph).

Figure 14: Transportable Hybrid Electric Power Stations (THEPS)



Description:

Mobile generators with solar panels, wind turbine, diesel generator, and storage batteries. DOD Power Surety Task officials expect THEPS to recoup costs within 14 months of deployment.

Status:

Four prototypes have been assessed at the National Training Center in Fort Irwin, California. Results have been shared with the HI-Power program. Task force officials said that improvements for THEPS have been identified, and that a few issues had been addressed. However, they believe that THEPS is not ready for deployment to Iraq.

Source: DOD Power Surety Task Force (photograph).

**Appendix III: Selected Initiatives of the DOD
Power Surety Task Force to Reduce Fuel
Demand at Forward-Deployed Locations**

Figure 15: Net Zero Plus Joint Capability Technology Demonstration



Description:

Intended to demonstrate energy saving strategies that can be employed at forward-deployed locations. The emphasis will be on replacing temporary living, office, and operational facilities with enduring energy efficient structures and integrating renewable energy technologies with improved energy generation to power those structures.

Status:

Intended to be demonstrated over 3 years in three phases, beginning in fiscal year 2008.

Source: GAO (photograph).

Figure 16: Monolithic Dome



Description:

Concrete, dome-shaped structure that is designed to be energy efficient with energy supplied by a combination of solar panels and windmills. According to a Power Surety Task Force official, the dome is 75 percent more energy efficient than a comparable structure of traditional design and technology.

Status:

Three domes were built and tested at the National Training Center.

Source: GAO (photograph).

**Appendix III: Selected Initiatives of the DOD
Power Surety Task Force to Reduce Fuel
Demand at Forward-Deployed Locations**

Figure 17: Tactical Garbage to Energy Refinery (TGER)



Description:

An experimental device that converts trash (paper, plastic, cardboard, and food slop) into energy for forward-deployed locations, reducing the need for convoys to deliver fuel and haul away trash. According to Power Surety Task Force officials, a production model TGER is expected to recoup costs within 18-24 months of deployment.

Status:

Two units have been tested in Iraq.

Source: Army (photograph).

Figure 18: Hybrid Electric Power Station



Description:

A hybrid generator system that uses wind and solar energy to supplement diesel generators.

Status:

Power Surety Task Force officials worked with the Army to test this initiative in Kuwait in late 2008.

Source: DOD Power Surety Task Force (photograph).

**Appendix III: Selected Initiatives of the DOD
Power Surety Task Force to Reduce Fuel
Demand at Forward-Deployed Locations**

Figure 19: Power Surety Feasibility Assessment



Description:

Power Surety Task Force has performed or is in the process of performing energy surveys to better understand fuel burdens at forward-deployed locations and to provide suggested actions on how to save fuel.

Status:

Ongoing

Source: GAO (photograph).

Appendix IV: Comments from the Department of Defense



THE JOINT STAFF
WASHINGTON, DC

FEB 5 2009

Reply ZIP Code:
20318-0300

Mr. William M. Solis
Director, Defense Capabilities and
Management
U.S. Government Accounting Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Solis,

This is the DOD response to the GAO draft report, GAO-09-300, "DEFENSE MANAGEMENT: DoD Needs to Increase Attention on Fuel Demand Management at Forward-Deployed Locations," dated 8 January 2009 (GAO Code 351172). Enclosure A is the DOD response to the GAO's recommendations. Enclosure B provides technical comments that the Department of Defense recommends incorporating for clarification.

Our technical comments reference the recently completed Army Energy Security Implementation Strategy. The Army completed this strategy after the GAO completed its review. Consequently, the information was not available until January 2009. Including these recommended changes will make the final GAO report current as it will reflect the latest Army guidance.

The Joint Staff point of contact is Lieutenant Colonel Richard Jones, USAF; J-4/SD, 703-571-9809.

Sincerely,

A handwritten signature in black ink that reads "W. E. Gaskin".

W. E. GASKIN
Major General, USMC
Vice Director, Joint Staff

**DEPARTMENT OF DEFENSE COMMENTS
ON THE RECOMMENDATIONS**

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense direct the Combatant Commanders, in consultation with their Service component commands, to establish requirements for managing fuel demand at forward-deployed locations within their areas of responsibility and provide specific guidance as appropriate. Officials may wish to consider identifying a triggering mechanism in the guidance, such as a specific length of time after a location is established, when fuel demand management should become a consideration in forward-deployed location sustainability. In establishing requirements, the Combatant Commanders should coordinate their efforts with the new DoD Director of Operational Energy Plans and Programs to ensure Department-wide communication and consistency, where appropriate.

DOD RESPONSE: Partially concur. Agree that managing fuel demand should become a consideration in forward-deployed location sustainability and that the Director of Operational Energy Plans and Programs will be part of establishing the threshold. However, the department believes that Combatant Commander must be the decision authority for when reduction efforts start getting tracked and what conservation measures are employed in order to avoid detracting from tactical operations.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense direct the Secretaries of the Army, the Navy, the Air Force, and the Commandant of the Marine Corps to develop guidance that implements Combatant Command requirements for managing fuel demand at forward-deployed locations. The guidance should include specific guidelines that address energy efficiency considerations in base construction, maintenance, procurement, and policies regarding fuel usage at a location. In establishing guidance, the Services should coordinate their efforts with the new DoD Director of Operational Energy Plans and Programs to ensure Department-wide communication and consistency, where appropriate.

DOD RESPONSE: Concur. Agree that the Services and Combatant Commands should develop guidelines that address energy efficiency considerations in base construction, maintenance, and procurement policies. Policies for fuel usage at each individual forward-deployed location will likely vary based upon equipment types and operations being conducted. Guidelines regarding policy will be general in nature and allow combatant commands flexibility. Additionally, once the framework for applying the Energy Efficiency Key Performance Parameter is established, the procurement process will properly weigh energy efficiency in the Battlespace.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense direct the Chairman, Joint Chiefs of Staff, to require that fuel demand considerations be incorporated into the Joint Staffs initiative to develop joint standards of life support at DoD's forward-deployed locations.

DOD RESPONSE: Concur.

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense designate the new, congressionally-mandated DoD Director of Operational Energy Plans and Programs as the Department's lead proponent of fuel demand management at forward-deployed locations.

DOD RESPONSE: Concur.

RECOMMENDATION 5: The GAO recommends that the Secretary of Defense require the DoD Director of Operational Energy Plans and Programs to develop action plans as part of the congressionally-mandated DoD energy strategy. Specifically, the strategy should incorporate the Department's action plans for: facilitating Department-wide communication and consistency, when appropriate, in the development or revision of Combatant Command and Military Service guidance that establish requirements and provide guidelines for managing fuel demand at forward-deployed locations;

- establishing incentives for Commanders of forward-deployed locations to promote fuel demand reduction at their locations, as well as identifying a viable funding mechanism for the Department and Commanders of forward-deployed locations to pursue fuel reduction initiatives;
- establishing visibility over fuel demand management at forward-deployed locations, including plans for sharing good fuel reduction practices and solutions to identified challenges; and
- establishing accountability for fuel demand management at appropriate levels across the Department.

DOD RESPONSE: Partially Concur. With regard to providing, "...a viable funding mechanism for...Commanders...to pursue fuel reduction initiatives," the department is not convinced that financial incentives represent the best fuel reduction strategy for forward deployed locations. The department will seek to incorporate reduction incentives while recognizing the primacy of mission accomplishment.

RECOMMENDATION 6: The GAO recommends that the Secretary of Defense direct the Secretaries of the Army, the Navy, the Air Force, and the Commandant of the Marine Corps to assign the new, congressionally-mandated Service senior energy officials, among their other duties, responsibility for overseeing fuel demand management at forward-deployed locations operated by their Service components. In carrying out this responsibility, the officials should identify and promote the sharing of good fuel reduction practices and solutions to identified fuel demand challenges at their Service component's forward-deployed locations and communicate those practices and solutions to the DoD Director of Operational Energy Plans and Programs for potential use across the Department.

DOD RESPONSE: Concur.

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

William M. Solis, (202) 512-8365 or solisw@gao.gov

Acknowledgments

In addition to the contact named above, Thomas Gosling, Assistant Director; Karyn Angulo; Alissa Czyz; Gilbert Kim; James Lawson; Marie Mak; and Ryan Olden made major contributions to this report.

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through GAO's Web site (www.gao.gov). Each weekday afternoon, GAO posts on its Web site newly released reports, testimony, and correspondence. To have GAO e-mail you a list of newly posted products, go to www.gao.gov and select "E-mail Updates."

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's Web site, <http://www.gao.gov/ordering.htm>.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm

E-mail: fraudnet@gao.gov

Automated answering system: (800) 424-5454 or (202) 512-7470

Congressional Relations

Ralph Dawn, Managing Director, dawnr@gao.gov, (202) 512-4400
U.S. Government Accountability Office, 441 G Street NW, Room 7125
Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, DC 20548