Operational Energy Base Camp Studies

Annotated Bibliography

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Final Report

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Abstract: Since the beginning of Operation Iraqi Freedom/Operation Enduring Freedom, there have been countless studies, assessments, and reports that have made recommendations on how to improve energy use in the expeditionary environment. While there have been many studies focused on reducing fuel demand in theater, to date, there has been no comprehensive review of existing studies, and limited data is available to draw conclusions. To address this need, the Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs [ASD(OEPP)] tasked the US Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) with reviewing all currently available energy relevant studies, assessments, and lessons learned; identifying recommendations made in those reports, appropriately categorizing those recommendations, and assessing them through various criteria (impact, investment, etc.) to measure progress for a given recommendation or category of recommendations. In this initial stage of work, the Project Delivery Team (PDT) performed a literature review to identify the results of all existing studies available dealing with expeditionary energy in the context of contingency basing. This report contains an annotated bibliography of those sources.
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Preface

This study was conducted for Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs [ASD(OEPP)] under Economy Act (Reimbursable) Order No. DWAM10565. The technical monitor was David King, Director of Current Operations, ASD(OEPP).

The work was managed and executed by the Energy Branch (CF-E) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL principal investigator was William T. Brown III. Franklin H. Holcomb is Chief, CEERD-CF-E, and L. Michael Golish is Chief, CEERD-CF. The associated Technical Director was Martin J. Savoie, CEERD-CV-T. The Director of ERDC-CERL is Dr. Ilker R. Adiguzel.

CERL is an element of the US Army Engineer Research and Development Center (ERDC), US Army Corps of Engineers. The Commander and Executive Director of ERDC is COL Kevin J. Wilson, and the Director of ERDC is Dr. Jeffery P. Holland.
1 Introduction

1.1 Background

US Code 10, Section138c defines operational energy as the “energy required for training, moving, and sustaining military forces and weapons platforms for military operations. The term includes energy used by tactical power systems and generators and weapons platforms.” Approximately 75 percent of the energy the US Department of Defense (DOD) consumed in 2009 was considered “operational” under this definition, while fixed installations accounted for the other 25 percent, largely for facilities and non-tactical vehicles. In practice, the DOD considers operational energy to be the energy used in:

- military deployments, across the full spectrum of missions
- direct support of military deployments
- training in support of unit readiness for military deployments (DOD 2011).

In a June 2011 message to the soldiers, sailors, airmen, Marines, and civilians of US Forces – Afghanistan (USFOR-A), GEN David Petraeus stated that energy used in the operational theater is:

the lifeblood of our warfighting capabilities and a key enabler of Coalition operations in Afghanistan.
However, high fuel use imposes risks to the mission and to each of us. In fact, nearly 80% of ground supply movements are composed of fuel, and we have lost many lives delivering fuel to bases around Afghanistan. Moreover, moving and protecting this energy diverts forces away from combat operations. A force that makes better use of fuel will have increased agility, improved resilience against disruption, and more capacity for engaging Afghan partners, particularly at the tactical edge.

Since the beginning of Operation Iraqi Freedom/Operation Enduring Freedom, there have been countless studies, assessments, and reports that have made recommendations on how to improve energy use in the expeditionary environment. While there have been many studies focused on reducing fuel demand in theater, to date, there has been no comprehensive review of existing studies, and limited data is available to draw conclusions.
To address this need, the Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs [ASD(OEPP)] tasked the US Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) with reviewing all currently available energy relevant studies, assessments, and lessons learned; identifying recommendations made in those reports, appropriately categorizing those recommendations, and assessing them through various criteria (impact, investment, etc.) to measure progress for a given recommendation or category of recommendations. The review will include:

1. A summary of study recommendations to date related to actions that can reduce energy use at small, medium, and large Forward Operating Bases (FOBs)
2. An analysis of data collected in theater related to actions either planned or already taken to reduce energy use at FOBs
3. Actionable near and long-term energy solutions for FOBs to include military capability, with an emphasis on scalable solutions for immediate implementation
4. A summary of policy recommendations that can help to reduce energy use in both the long and short term at FOBs.

The first stage of this project was to review the available information sources and to identify those sources that contained recommendations relevant to project objectives.

1.2 Objectives

The general objective of this work was to establish a greater understanding of the problems and solutions of operational energy in the context of contingency base camp development and management. Specific objectives of this work were to:

1. Collect data in Afghanistan to characterize contingency base energy use
2. Develop recommendations and implementation strategies (based on data collected from theater) for organic deployment of “low hanging fruit” energy solutions for FOB energy management
3. Suggest short and long-term solutions that address systemic contingency basing and operational energy challenges
4. Summarize policy recommendations that can help to reduce energy use in both the long and short term at FOBs.
The specific objective of this stage of work was to perform a literature review and identify the results of all existing studies available dealing with expeditionary energy in the context of contingency basing.

1.3 Approach

In this stage of work, the ERDC-CERL Project Delivery Team (PDT) performed a literature review consisting of:

1. A meta-study to collect and analyze the results of all existing studies available dealing with expeditionary energy in the context of contingency basing
2. Identification of progress to date on implementation of the studies’ recommendations
3. For those recommendations that have been implemented, identification of impacts (using metrics) on FOBs) in each category (small, medium, large).

1.4 Scope

This work focused primarily on issues specifically related to the improvement of energy use and reduction of demand for energy in the expeditionary environments of Operation Iraqi Freedom/Operation Enduring Freedom (Iraq and Afghanistan). This work did not consider energy reduction issues related to: (1) personal gear (e.g., “plug loads” created by radios, electronic equipment, or batteries carried by Soldiers in theater), (2) vehicle reduction, (3) the use of aircraft. However, attention was also given to issues related to water conservation since transportation and processing of water in theater are energy-intensive activities.

1.5 Mode of technology transfer

This report will be made accessible through the World Wide Web (WWW) at URL: http://www.cecer.army.mil/
2 Annotated Bibliography


This report summarizes the benefits of metering as a cost-effective way for the Navy to comply with anticipated legislation that will require all Federal facilities to have advanced electric meters “to the maximum extent possible.”


This website gives a very general description of the location and structure of geothermic reserves in Afghanistan, and their potential for generating electricity.


This PowerPoint presentation presents a general outline and definition of a base camp and its functions, including staffing (examples in practice), training, policies and practices, and recommendations.


This PowerPoint presentation gives an introductory overview of base camps.


This PowerPoint presentation describes how the US Army Materiel Command (AMC) will field an Army enterprise system to Operation Enduring Freedom (OEF) in fiscal year 2011 (FY11) capable of tracking fuel requirements, inventory, and consumption to the retail level.


This report summarizes the main findings associated with the evolution of the engineer roles and missions in the Iraq Theater as the Army struggled with command and support relationships that maximize the capability of these limited high demand engineer resources.


This report summarizes the Engineer’s role in Afghanistan in 2010.


This PowerPoint presentation gives an overview of the technologies and timeline with the NetZero Plus JCTD study.
This report summarizes the trip taken by the Assistant Secretary of the Army for Installations, Energy and Environment (ASA[IEE]), along with a technical team of subject matter experts (SMEs) on 19-25 February 2011. The team visited selected bases in Iraq, Afghanistan, and Qatar to see firsthand the environmental and operational energy issues and challenges associated with contingency base operations, to gain a better understanding of the complexities associated with their initial establishment, i.e., the transition to “enduring,” transfer/drawdown, sustained operations, and base camp management.


This report suggests that a single medium-sized biodiesel plant in Afghanistan can achieve five benefits: (1) casualties can be reduced by four to five soldiers a year, (2) about 120 soldiers can be reassigned from fuel convoys to new missions, (3) millions or billions of dollars can be saved each year, (4) up to 50% of the poppy crop can be replaced by a biodiesel crop, and (5) a new industry may be created that, over time, can greatly benefit the Afghan people.


This white paper provides a framework to guide development of power and energy capabilities that support Army requirements in the near-, mid-, and long-term. The document projects operational needs, identifies important performance attributes, assesses relevant technology opportunities, recommends priorities for future investment, and describes an implementation approach linking ongoing initiatives and plans with a coordinated path forward.


This report describes the MAESMO project, which was designed to investigate tools, models, and databases that are currently used or could be used in the Army to analyze energy alternatives in support of operational missions. The project was also intended to recommend modifications to existing capabilities and identify new analytic capabilities that should be developed. Study objectives were to: (1) specify and assess a baseline architecture of existing energy-related processes and models in the Army analytical community, (2) identify areas in the baseline architecture that should be sustained and expanded, and identify where new capabilities should be developed to support operational mission and energy policy requirements, and (3) develop and illustrate a cost-benefit methodology for evaluating energy choices in support of operational missions.

This study found that: (1) Army analysis agencies have substantive existing and prospective capabilities for: evaluating energy efficiency as a Key Performance Parameter (KPP), calculating and applying the fully burdened cost of fuel (FBCF) for Analysis of Alternatives (AoA) and other cost-benefit analyses, and modeling energy in combat/combatt service support models (to be part of cost-benefit
analysis). Standardization in development and application of these capabilities is necessary to effectively implement recently enacted energy policies; (2) Proposed enhanced architecture provides a reusable methodology for evaluating the costs and benefits of energy technologies (and technologies that impact energy production and use) in support of Army operational missions.

The report recommends that: (1) the US Army Materiel Systems Analysis Activity (AMSAA) expand its initiative for collecting actual fuel consumption data (from theaters of operations) to all major energy consuming systems; (2) the US Army Combined Arms Support Command (CASCOM) develop planning factors and allocation rules for alternative/renewable energy (RE) and energy efficiency (EE) technologies; (3) the TRADOC Analysis Center (TRAC) Logistics Battle Command Model be expanded to integrate energy logistics and technologies with combat/operations modeling and analysis – model energy as an independent variable; (4) FBCF development and Army-wide implementation be standardized.


This document presents the Army’s energy security vision, mission, and goals, and clarifies its work to develop objectives and metrics to gauge progress toward the goals of the Army Energy Security Implementation Strategy (AESIS).


This appendix to the Air Force Energy Plan serves as the operational framework for all military and civilian Air Force personnel in communicating Air Force acquisition energy goals, objectives, and metrics.


The Air Force Energy Plan serves as the operational framework for all military and civilian Air Force personnel in communicating the Air Force energy goals, objectives, and metrics.


This paper investigates the FBCF as it relates to the procurement of warfighting systems. Areas of specific inspection include: reducing theater fuel transportation requirements to forward-operating bases, reducing fuel needs with more efficient living and work environments, adding energy-efficiency key performance parameter requirements for DoD warfighting acquisitions, assessing the potential influence on operational effectiveness and force structure, and examining the second- and third-order effects across the three DoD Decision Support Systems—requirements, budget, and acquisition—colloquially referred to as the “Big A.”

This PowerPoint presentation summarizes TARDEC’s water supply mission, and describes currently available and new and emerging water treatment technologies.


This study conducted an infrared (IR) assessment of the main administration building located at Summit Station, Greenland. This IR survey was conducted to identify existing deficiencies in the building that may diminish the energy efficiency or compromise the structural performance, reducing the building’s service life. This evaluation found that, in the extreme climate where the Big House is located, the structure is performing quite well after 20 years of service. The most significant issue is heat loss in localized areas through the building envelope. No major structural issues were observed.


The US Army, Navy, Marine Corps, and Air Force have all established programs geared toward reducing dependence on the use of fossil fuels in tactical weapon systems such as aircraft, combat ships and vehicles, and supporting equipment. This monograph examines alternative fuels that might be candidates for military applications within 10 years, with emphasis on those that either have been or are currently the focus of research, testing, and certification within the Department of Defense (DoD). Discussed are each fuel’s economic viability, technical readiness for commercial production, lifecycle greenhouse gas emissions, and approaches that could be used to reduce those emissions. Also examined is the military utility of mobile, in-theater synthetic fuel processes. The authors conclude that DoD goals for alternative fuel use in tactical weapon systems should be based on potential national benefits because the use of alternative fuels offers no direct military benefit over the use of conventional petroleum-derived fuels.


This document holds that, if the US military services are indeed to use alternative fuels in tactical weapon systems, these fuels must be able to substitute for one or more of the three petroleum-based distillate fuels that currently support the majority of military operations: the two military jet fuels, JP-8 and JP-5 (where “JP” stands for “jet propellant”), and naval distillate (F-76). From the perspective of technical viability, a number of alternative fuels can meet this requirement, but uncertainties remain regarding their commercial viability—namely, how much these fuels will cost and what impact they may have on the environment, particularly in terms of greenhouse gas emissions. For its review of concepts for producing alternative fuels in theater, the RAND team drew on the experience of RAND defense analysts and active-duty military officers working as RAND fellows to analyze the Defense Department’s and private sector’s efforts in the area of alternative fuels. It found that the additional investment required to
construct large amounts of generating capacity dedicated to producing alternative fuels is probably not feasible. For at least the next two decades, it is highly unlikely that hydrogen from nuclear or renewable electric-generating technologies will be a commercially viable option for producing alternative fuels.


This memorandum updates Sustainable Design and Development (SDD) policies for Army facilities.


This quad chart describes the Afghan Microgrid Project (AMP).


This paper suggests steps the US military can take to reduce energy consumption by first examining its current electricity generation and distribution systems. The paper identifies criteria for expeditionary military equipment sets. Following the criteria, the paper examines solar panels, wind turbines, and rechargeable batteries and their applications in a bare base environment. The uses manufacture’s specifications and notional applications paper to evaluate renewable energy systems with the identified criteria.


This report assesses battlefield energy use and evaluates capabilities that might help the Marine Corps reduce fossil fuel use in an expeditionary environment.


This guidebook was developed by a multinational working group consisting of representatives from the defense organizations of Finland, Sweden, and the United States. It reflects a shared commitment to proactively reduce the environmental impacts of military operations, and to protect the health and safety of deployed forces. Any successful military operation begins with sound planning. This guidebook gives operational planners the necessary tools to incorporate environmental considerations throughout the life cycle of the operation. Failure to integrate environmental considerations into operational-and tactical-level planning increases the risk to the health and safety of military personnel and civilian non-combatants. Inadvertent damage to the natural environment or to significant cultural or historic resources also complicates the attainment of the desired strategic end state through the loss of political capital, negative public image, and increased overall cost.

Brown, William T., John Vavrin, Tarek Abdallah, Jarod Delhotal, Roch Ducey, Franklin H. Holcomb, Nicholas A. Reisweber, Patrick J. Sioson, Chang W. Sohn, William

This report summarizes a site-specific feasibility study to assess the potential use of renewable energy to reduce or replace planned fossil-fueled generators at the Afghanistan National Security University (ANSU) and its supporting facilities located in Qargha, Kabul, Afghanistan. The team investigated the following technologies: solar photovoltaic (ground-mounted and building-integrated), solar domestic hot water (DHW), wind, geothermal, geo-thermal (ground-source) heat pumps, waste-to energy (including biomass), solar air collector, solar air ventilation, fuel cells, and hydroelectric power. Qualitative facility demand and energy reduction measures were also included. On review of all potential options, it was determined that seven renewable energy systems were viable, and eight renewable energy technologies were not viable.


The brief gives an overview of power grid structures for German FOBs already in use at Camp MARMAL, Mazar-e Sharif.


This memorandum discusses the Expeditionary Energy Summit at the US Central Command (USCENTCOM) on 5-6 May 2011, which brought together senior leaders from across the Department to identify a path forward for deploying operational energy solutions to improve warfighter capability in the USCENTCOM Area of Responsibility (AOR). Panel discussions produced key findings related to expeditionary energy, base camp management, and contingency contracting, which informed a range of near- and long-term action items.


This presentation describes Worldwide & Solar Technologies, Inc.’s standalone, self-contained, silent and solar-powered modular water treatment plant, which maintains 24/7 sustained operations. The system purifies water from fresh, brackish, and salt water sources, and delivers up to 30,000 gal of purified water per day. They system is easily transported by land, air, or sea and can be made operational within 30 minutes of arrival on site, in any geographical location. The technology a quick payback, less than 1 cent/gallon. The system promises to minimize concerns about fuel logistics, costs, and security.
This PowerPoint presentation identifies 10 Energy Reduction Opportunities in Theater: (1) improving building envelope air tightness, (2) improving power generation efficiency, (3) replacing inefficient dining equipment, (4) installing efficient lighting, (5) using hot water heat recovery, (6) improving building insulation, (7) restricting occupant behavior, (8) using fewer fans/ environmental control units (ECUs), (9) installing exterior shading and window tinting, and (10) instituting an information campaign to reduce user power demands.


This manufacturer's website describes a liquid ceramic insulation called “industrial ceramic.” This product was developed as a roofing material, was later improved using a quality resin (binding) system and ceramic beads in an effort to produce a material that could replace the tiles used on the space shuttle. While the current TC Industrial ceramic formula can only withstand temperatures up to 500 °F, it does have some insulation properties.


This report builds on the previous finding that “climate change, national security, and energy dependence are a related set of global challenges” by considering the security risks inherent in America's current energy posture, energy choices the nation can make to enhance our national security, the impact of climate change on our energy choices and our national security, and the role DoD can play in the nation's approach to energy security.


This Theater Energy and Efficiency Master Plan (E&E Plan) identifies technologies and solutions with economic, environmental, and social benefits that support US military operations to address infrastructure and facility issues. This E&E Plan submittal is Phase 1 of a two-phased project. The next phase will address technologies to increase energy efficiency, such as: the shift to prime power and mini-grids (from spot generation), alternative technologies (such as solar and wind), and means of overall energy reduction (such as increasing local material use).


This instruction provides guidance concerning the selection and vulnerability of fuels for shore facilities including specific criteria for providing utility services and/or selecting energy sources for naval heating or power plants.
This instruction issues policy, objectives, and goals, and assigns responsibilities for energy management for non-nuclear ships, aircraft, vehicles, and shore installations.

This instruction issues policies, objectives and goals, and assigns responsibilities for energy management for the Navy.

This instruction outlines requirements for proper management and accounting for ground fuels. Evaluation of energy factors will be mandatory when awarding contracts for systems and buildings; industry will be held contractually accountable for meeting energy efficiency targets.

This document conveys strategic imperatives that align with Department of the Navy energy targets announced at the 2009 Naval Energy Forum and in the Energy Awareness Message to the Fleet.

Prior studies have estimated that a liter of bioethanol requires 263-784 L of water from corn farm to fuel pump, but these estimates have failed to account for the widely varied regional irrigation practices. By using regional time-series agricultural and ethanol production data in the United States, this paper estimates the state-level field-to-pump water requirement of bioethanol across the nation. The results indicate that bioethanol’s water requirements can range from 5 to 2138 L per liter of ethanol depending on regional irrigation practices. The results also show that as the ethanol industry expands to areas that apply more irrigated water than others, consumptive water appropriation by bioethanol in the United States has increased 246% from 1.9 to 6.1 trillion liters between 2005 and 2008, whereas US bioethanol production has increased only 133% from 15 to 34 billion liters during the same period. The results highlight the need to take regional specifics into account when implementing biofuel mandates.

This document addresses the increasing importance of sustainability in full spectrum operations as a force multiplier through increased operational
efficiencies, reduced logistical burdens, reduced costs, and employing Science and Technologies (S&T) initiatives as needed. It identifies gaps in existing S&T related to full spectrum operations and related systems (e.g., water, wastewater, solid waste, operations and facilities, and renewable energy). The initial focus of this research effort is on FOBs and related systems such as water, wastewater, solid waste, renewable energy, etc. The expected result of this effort is a short-, mid- and long-term strategy, structured along a timeline, for sustainable full spectrum operations and the roadmap to visualize such a sustainable strategy for the US Army. This effort will help tie S&T sustainability initiatives focused on full spectrum operations into coherent policy guidance to better use limited resources to ensure that the Army is addressing its present and future sustainability needs, and that it is improving its ability to organize, equip, train, and deploy its forces.


The Defense Logistics Agency Energy Fact Book (intended for general information purposes only) contains information regarding DLA business operations and reflects the operational status at the end of FY10.


This website contains training information for the “Fleet Card” system, which is used for fuel dispensing and tracking of fuel.


The Aviation Operations Energy Plan is an appendix to the Air Force Energy Plan that serves as the operational framework for all military and civilian Air Force personnel in communicating aviation energy goals, objectives, and metrics.


This manufacturer’s web page described DuPont™ Tyvek®, a weather-resistant, breathable “wrap” commonly used to increase air and water resistance in the construction industry, and as cover material for cars, boats, and campers.


This report discusses the cost to transport fuel and water to bases in theater.


This memorandum directs all Army organizations to comply with green procurement requirements.

This PowerPoint presentation illustrates the use of Glass Inc., High Temperature (HT) batting to reduce noise, and to provide thermal insulation and fire resistance to technical shelters and other applications. The shelter linings can withstand high heat (up to 2000 °F for hours), and offer energy savings from 40 to 75%, which converts to a simple payback period of 30 to 45 days. Shelter linings may be retrofit to existing tent structures and integrated into next generation structures.


This plan provides a guideline for fuel and energy efforts in the tactical environment from 2010 to the 2016-2028 future force timeframe. The plan establishes timelines, identifies tasks, assigns responsibilities, and establishes metrics to measure progress in meeting the energy security goals prescribed in the AESIS. The plan will be executed under the direction and governance of the Army Senior Energy Executive, ensuring the synchronization of efforts aimed at meeting the Army’s overall energy security vision, mission, and goals.


This PowerPoint presentation gives an overview of equipment/power requirements at: (1) India company Ex-FOB, (2) Lima and Kilo Company, (3) Battalion Combat Operations Center (COC) review/recommendations, and (4) additional Ex-FOB equipment considerations.


This paper summarizes an approach to improving energy efficiency by straight-line reduction in power consumed, flexible power consumption, and enhanced power production.


This report summarizes the results of a demonstration that monitored, documented, trended, and analyzed diesel generator power production and associated fuel consumption at Camp Phoenix, Afghanistan to perform energy baseline analyses. The work concluded that: (1) the installation of the data loggers allowed for the successful collection and recording of power generation data; (2) spot generation is an inefficient means of power generation; and (3) the installation of data logging equipment benefits any site in the effort to establish baseline data of electrical infrastructure and make continual improvements. Recommendations were to: (1) use data logging equipment when considering combining loads on one generator or consolidating generators; (2) consider installing load monitoring instrumentation when generators are overhauled or when major repairs are made; (3) replace spot generation with parallel power generation units where practical, and (4) assign energy management roles and

* Evaluation, Measurement & Verification (EMV).
responsibilities at FOB level to track energy use and implement fuel savings initiatives.


This brief describes operational energy and its risks, and gives an overview of Air Force fuel use and planning consideration for gauging supplies. It also makes specific recommendations on ways the Air Force can reduce energy (fuel) demand.


This article describes two utility systems the Marine Corps and the Army are sending forward to forces in Afghanistan that will let them transform any kind of water (even seawater) into safe drinking water: (1) the lightweight water purification system, and (2) the tactical water purification system.


This report provides information regarding: (1) the benefits of using minigrid systems and central power plants at FOBs in theater versus spot generation, (2) the logistical and procurement difficulties encountered by commanders on the ground implementing minigrids and reducing spot generation, and (3) the acquisition path forward for implementation of minigrids.


This paper proposes a framework modifying Government appropriations to support a permanent DoD energy efficiency incentive at every level of leadership in both deployed and non-deployed environments.


This report proposes a $25 billion per year investment channeled through a reformed energy innovation system built on a four-part energy framework: (1) investment in energy science and education, (2) an overhaul of the energy innovation system, (3) the reform of energy subsidies and use of military procurement and competitive deployment to drive innovation and price declines, and (4) the internalization of the cost of energy modernization to ensure that investments do not add to the national debt.


This ETL (which supersedes ETL 09-18, External Foam Insulation of Temporary Structures, dated 18 November 2009) provides guidance for the application, use,
and disposal of external spray-on closed-cell foam insulation on temporary structures, particularly those in the Iraq and Afghanistan AOR. This ETL also describes required modifications to and operational requirements of those structures. Foam insulation is intended to achieve reductions in electrical demand, bulk fuel requirements, and convoy sorties, while improving quality-of-life conditions for military personnel.


This regulation sets policy for tactical water resources management. It defines the Army role in tactical operations and outlines responsibilities for tactical water support. This regulation does not apply to fixed installation water support operations or civil works emergency water management.


FM 3-34 is the Engineer Regiment’s keystone manual for operating in today’s operational environment (OE) within the framework of full spectrum operations. Although focused at the operational to tactical level, it is applicable for all levels of war.


This manual provides engineer doctrine for operating at the BCT and below and within the framework of full spectrum operations. It describes engineer operations integrated through the warfighting functions in a combined arms application of combat power, and provides detail for commanders and staff at brigade echelons and below to ensure synchronization of engineer capabilities throughout operations and across the spectrum of conflict and applied operational themes.


Field Manual (FM) 3-05.230 is a “how to” guide for Special Forces (SF) conducting joint and combined operations. It provides references and describes tactics, techniques, and procedures for establishing base camp operations.


This manual provides doctrine to commanders and staffs concerning the employment of engineer units at echelons above corps (EAC). These units will be required to construct, maintain, and rehabilitate the logistical infrastructure needed for operational sustainment of the combat forces. Some EAC engineer units may operate as far forward as the corps rear area, but generally most will operate in the communications zone (COMMZ).

This document provides general instructions and detailed technical guidance and recommendations for the sanitary control and surveillance of land-based field water supplies. Adherence to the guidance and recommendations in this document will help ensure that water produced, treated, and provided by US Military Services and contractors in the operational environment is of the highest quality possible and that it will support and sustain the health and performance of deployed personnel.


This EP was written to support base camp development. Its primary purpose is to provide a detailed discussion of the topics presented in the USACE Base Camp Development Planning (BCDP) Course. Base camp development planning is one of the five considerations and processes that contributes to the overall lifecycle of base camp development (see field manual [FM] 3-34.400). This pamphlet focuses primarily on the engineer-specific areas of base camp planning. This EP is not specific to any single functional or geographic combatant command, but provides general planning guidance that the user must analyze, refine, coordinate and, ultimately, adapt to meet the CCDR’s guidance and needs.


This ECB provides guidance for the application of external, spray-applied polyurethane foam (SPF) insulation to tents and temporary structures, located in contingency locations, such as Iraq and Afghanistan.


This document is the primary field manual to define the engineer function of General Engineering (GE); it is designed primarily to assist Army engineers at all echelons in planning and coordinating GE operations at the strategic, operational, and tactical levels. It is also a resource applicable to DoD, Joint, and other Army organizations and agencies that have a role in supporting, establishing, and/or maintaining the infrastructure required to conduct and sustain military operations.


This TRADOC pamphlet provides the foundation to facilitate a CBA with respect to the future Modular Force capabilities requirements associated with base camps. It addresses planning and design, construction and deconstruction, and operations and management of base camps across the spectrum of conflict. This
pamphlet assumes these operations will be conducted across the full spectrum of military operations within a joint, interagency, intergovernmental, and multinational (JIM) environment.


This one-page brief describes energy efficient tent enhancements and rigid structure replacements.


The 2006 International Energy Conservation Code (IECC) is the model energy code applicable to conditioned, commercial buildings, i.e., anything other than a low-rise (1-3 stories) house, condominium, or apartment (R-2, R-3, and R-4).


The Army establishes base camps in a wide variety of deployment situations. Each base camp is unique, and the Army must be prepared to provide power, water, wastewater disposal, and solid waste disposal in any environment. Site conditions affect how base camps can be deployed and thus how utilities can be provided. The technologies chosen to provide these services largely depend on pre-deployment conditions, the number of personnel deployed, and the duration of encampment. It is important that the technologies used to provide utility services to base camps not compromise the deployable and sustainable aspects of a contingency force. It is also important that the health and security of the soldier be maintained at the highest level possible within the constraints of deployment. This report documents a study that evaluated technologies currently in use or available to provide utility service to base camps. The information is organized to allow easy comparison of the four primary utilities, making it a useful decision tool during Army base camp planning.


This PowerPoint presentation describes USPACOM efforts to further develop photo-voltaic energy in the nation of Palau.


This article describes the US Army Expeditionary Water Packaging System (EWPS), which can reliably produce 600–700 1-liter bottles per hour, and in theater, is producing more than 500 bottles of water per hour and operates 6 days a week.

This document outlines fundamental principles and guidance for providing bulk petroleum and water in support of US military operations.


This presentation summarizes “the business case” related to man-portable power technologies. The last slide gives a list of appropriated Research, Development, Test, and Evaluation (RDTE) projects.


This interview consisted of a discussion of the Tactical Fuels Manager Defense (TFMD) site, its contents, data collection methods, and issues concerning data collection at sites. Mr. Kirk also discussed future plans for additional TFMD’s sites and further data collection methods at the generator level. His experience in Iraq’s fuel management system also gave insight on how fuel was handled and stored in theater.


This report explores the institutional impediments that prevent the Army from increasing its use of renewable energy systems in contingency operations and make recommendations to overcome those barriers to enhance use of renewable energy and to thereby become less dependent of foreign oil.


This report summarizes the results of an assessment undertaken to identify USAF energy efficiency improvement opportunities in a deployed environment.


This Quad Chart describes current and future energy efficiency measures to reduce logistical requirements of power production.


This PowerPoint presentation summarizes the potential benefits of geothermal power for the expeditionary and fixed environments, but also states that technological advances would be needed before deploying geothermal power at FOBs. The presentation does not quantify potential fuel savings or available geothermal plant capacities. Supporting information quantifies different fully burdened costs from large to small FOBs, and a slide that summarizes Camp Leatherneck’s daily fuel consumption.

This article explores the thesis that climate instability may lead to many local political, social, and economic instabilities, and therefore to global insecurity.


This article summarizes DoD fuel consumption initiatives in Afghanistan since 2006, and cites the need for an overall strategy that tracks energy consumption and that coordinates renewable energy technology initiatives.

Mears, Ed. 6 December 2011. USFOR-A Biogas Digesters. USFOR-A.

This PowerPoint slide describes the Contracting Process for Prompt Payment (CERP) project for the rehabilitation of an Afghan Ministry of Energy and Water (MEW) biogas plant, which broke ground on 13 December 10. Plant construction was completed on 11 January 2011, after which the CERP contract included 4 months of operations and maintenance (O&M). Gas generation began between 7 March and 1 April 2011.


This news article summarizes the US Navy’s response to a Rand Corp. report that said the biofuels the Navy is pursuing could not be made commercially viable in the short term and would not reduce emissions from current levels. The Navy is one of the biggest single consumers of jet fuel behind commercial airlines, which lack the resources and the time to develop the fuel. Consequently, the Navy has made development of biofuels a key part of its research and development. Navy Secretary Ray Mabus had made it a goal to sail an alternative energy “green fleet” by 2016 and increase alternative fuels to 50 percent of Navy operations by 2020. A Navy spokesman claimed that 2012 to 2016 will mark the emergence of a mature biofuels industry.


This PowerPoint presentation briefs the 72 mission requirements for battery loads that soldiers are required to carry. Suggestions are made for the future generation of batteries and their advantages.


This commercial product demonstration web page contains a video illustration of the Kärcher Futuretech Expeditionary Water Packaging System, which claims to “bottle water in the field from any potable water source, relieving logistical and operational challenges of transporting large quantities of bottled water across unsafe areas.”


This PowerPoint presentation summarizes the logistical problems encountered in the Afghanistan theater, and makes recommendations to reduce transport of fuel and water in theater.

This final report summarizes the activities and recommendations of the Afghanistan MEAT, which was directed to visit at least two bases and spend 2-3 days at each to develop a comprehensive assessment of power consumption and to compare consumption with other bases in theater. The team determined that the following deliverables should come from the assessment: (1) A realistic measurement of the FBCF for Marine Forces in Afghanistan; (2) recommendations for realistic and achievable measures that could result in near-term energy savings that should reflect a holistic approach including demand reduction and supplemental alternative supply sources; (3) a cost/benefit analysis to inform decisions about future policy, operational concepts, and tactics techniques and procedures (TTPs), and procurement decisions; and (4) similar analysis and recommendations for reducing the cost and risk of providing water to Marines.


This brief addresses whether mature technologies exist that can: (1) use existing power generation more efficiently, (2) generate power more efficiently than can the tactical quiet generator (TQG), and (3) supplement power generation with renewable energy technologies to reduce the number of generators required.


This PowerPoint presentation reviews the capabilities of the US Army Force Provider System, including descriptions of energy efficient structures, tent cooling and heating and other tent enhancements, power generation, and solid waste management. The presentation also lists ongoing projects at the Base Camp System Integration Lab (SIL).


This spreadsheet lists seasonal (summer/winter) statistics for: fuel (consumed), water (trucked in, graywater generated and blackwater generated), and solid waste (generated) for a Platoon Expeditionary Camp (PEC) and Expeditionary Base Camp (EBC).


This PowerPoint presentation examines the national security threats associated with energy, and the appropriate role for DoD in addressing these threats.


This PowerPoint presentation gives a general summary of the relationship between energy and risks to national security.

This document discusses the use of HOMER (a computer model that simplifies the task of evaluating design options for both off-grid and grid-connected power systems for remote, standalone, and distributed generation (DG) applications) as a pre-deployment tool to evaluate power solutions for the Marines. HOMER’s optimization and sensitivity analysis algorithms allow the user to evaluate the economic and technical feasibility of a large number of technology options and to account for uncertainty in technology costs, energy resource availability, and other variables. HOMER models both conventional and renewable energy technologies.


This PowerPoint presentation summarizes the Marine Corps’ research and development (R&D) into its “Experimental Forward Operating Base Process” for testing and incorporating energy-saving technologies into FOB operations, and lists “most promising capabilities available ... with official requirements documents approved.”


This PowerPoint presentation describes the mission of the E2-O, the functional advocate for USMC expeditionary energy to analyze, develop, and direct the Marine Corps’ energy strategy to optimize expeditionary capabilities across all warfighting functions.


This report characterizes current FOB design and operations as a first step in developing more sustainable FOBs.


This article describes the logistical fuel support provided to Soldiers at Contingency Operating Base (COB) Speicher in Iraq and across Multi-National Division-North (MND–N) during Operation Iraqi Freedom 08–10 by the 16th Sustainment Brigade’s 391st Combat Sustainment Support Battalion (CSSB) and the 3d Expeditionary Sustainment Command (ESC). COB Speicher fuel operations featured a fuel farm and a retail fuel point; the fuel farm and retail point received fuel tankers, downloaded the fuel, processed receipts, made issues, accounted for the fuel, and maintained the facilities. Fuel farm employees captured all the bulk fuel transactions (receipt and issue) with related temperature conversion readings and entered the resulting data into the web-based Fuels Automated System Enterprise Server (an automated information system designed to support Defense Energy Support Center [DESC] and the services in performing their responsibilities in fuel management and distribution).
Office of Naval Research, Naval Research Laboratory, National Energy Technology Laboratory, National Defense University. 21 May 2004. DoD Future Energy Resources: Proceedings of Workshops Held at the National Defense University. This report summarizes the two workshops that explored renewable energy technologies: biomass, hydrogen, gas hydrates, and energy derived from the oceans.


Parthemore, Christine, and John Nagl. September 2010. Fueling the Future Force Preparing the Department of Defense for a Post-Petroleum Era. Washington, DC: Center for a New American Security (CNAS). This report proposes that the DoD should ready America’s armed forces for tomorrow’s challenges by transitioning all of its systems away from petroleum fuels by 2040

Perez, Linda. 2011. Alaska Coastal Management Program Consistency Review, Amchitka Base Camp—Department of Energy. Online Public Notice. Anchorage, AL: Division of Governmental Coordination State of Alaska. This document summarizes the US Department of Energy (USDOE) proposal to establish a temporary base camp on Amchitka Island, Alaska. The camp will support approximately 150 individuals involved in various remediation activities on Amchitka. The base camp is anticipated to cover approximately 1 acre in area and will be located in the vicinity of the existing military runways (Baker, Charlie, and Fox) on the southeast tip of the island near Constantine Harbor.


This report provides a brief overview of the important initiatives DoD has undertaken to lead in energy strategies and technologies.


This report discusses the mandates for and development of renewable energy technologies in the DoD. It focuses on those technologies presently competing for incorporation into mainstream DoD activities. Also discussed are conservation actions.


This PowerPoint presentation illustrates the Army’s efforts for energy reduction, i.e., the Afghanistan microgrid project, fuel efficient gensets, energy efficient environmental control units, shower water reuse system, waste to energy, energy efficient shelters, energy efficient lighting, water well drill rig system, and common driver system training.


This PowerPoint presentation outlines Mobile Electric Power (MEP) organization/systems, requirements and challenges, major initiatives, and technology thrusts.


This PowerPoint presentation summarizes DoD energy goals, and tracks its progress through FY10 in meeting those goals.


This PowerPoint presentation summarizes the evolving technological solutions that will create a “paradigm shift” that will overcome the challenges to creating sustainable FOBs.


This report summarizes a study done to facilitate geological studies, geophysical exploration, and drilling programs to characterize reservoirs and the capacity of Afghanistan’s geothermal prospects. Many geothermally active areas are
currently known with surface manifestations in the form of hot springs, which demonstrate the wide perspective of development and utilization of geothermal prospects in this country. Further geological, geochemical, and geophysical exploration is required to characterize the reservoirs of numerous geothermal prospects in Afghanistan for possible electric power generation and other technologically advanced uses of this renewable energy resource. Use of geothermal energy in Afghanistan is realistic. However, it is suggested that at this stage, direct use of geothermal energy is the most feasible way to put this abundant renewable energy resource into use. In this framework, there is tremendous potential for applications such as in the food processing, fruit drying, carpet and wool processing, chemical industry, greenhouse industry, fish hatchery and farming, refrigeration, and many other small-scale local industries.


This document provides guidance on Air Force office responsibilities and the energy program. The Air Force Instruction (AFI) establishes the cross-functional governance and management structure at all levels of the Air Force to execute its energy policy.


This document contains the statement testimony of Mr. Alan Shaffer Principal Deputy, Defense Research and Engineering Before the United States House of Representatives Committee on Armed Services, Subcommittee on Terrorism, Unconventional Threats and Capabilities. Mr. Shaffer summarizes how the DoD, under the coordination of the Energy Security Task Force, has improved its energy posture through increased collaboration, resulting in an overall decrease in energy consumption DoD-wide. He cites numerous demonstrations and other projects to reduce consumption and increase assured alternatives for installations, both fixed and tactical and weapons systems, with anticipated savings from five to 25 percent. He further describes how technologies that make good financial and operation business sense are being implemented on a wider scale to improve the Department’s energy posture by reducing costs and enabling sustained, uninterrupted operations while putting fewer service members in harm’s way.


This report summarizes vendor demonstrations done the week of 9 August 2010, at Experimental Forward Operating Base Phase IV, held at Twentynine Palms CA. Vendors exhibited technologies focused on reducing fuel usage and its impact on the logistics burden in the field. Eleven companies demonstrated 14 technologies: (1) “Efficient utilization of generators” (three companies); (2) The M3S microgrid system (Honeywell); (3) A variable frequency 100kW diesel generator hybridized with a small li-ion battery pack (BAE); (4) “Efficient heating and cooling of tents” (ETI); (5) “Efficient utilization of generators” (ETI); (6) “Efficient water cooling” (DynGlobal); (7) 10,000 BTU DC air conditioning unit powered by solar panels (SunDanzer); (8) Solar powered DC chest freezer (SunDanzer); (9) two different foamed tents (Honeywell); (10) two technologies for insulating a Base-X 305 tent; (11) Ready Fold flooring to reduce heating from
the desert floor in a Base-X 305 tent (HDT); (12) Temp Shield Radiant Blanket was attached to Base-X 305 tent walls and ceiling (HDT); (13) Solar Off-Loading Technology (S.O.L.T) (INCA); (14) Rteq insulation applied to a tent (Johnson Outdoors Group [JOG]).


This two-page monthly project status report gives a technical summary of the AMP - 1 megawatt (MW) microgrid, 180kW microgrid, and 3 kW hybrid.


This report identifies three significant gaps between current Air Force energy policies and initiatives and the desired state laid out in the Air Force Energy Plan 2010: (1) the need to recognize energy as a mission critical asset, (2) the need for funding, information, and analytical tools to make informed decisions on project priorities and performance to implement the AF Energy Plan, and (3) the need to establish specific energy performance relationships and tradeoffs requirements for weapons systems, operations, and installations.


This paper examines joint management of "bare base systems." First, it describes existing bare base capability. Next, it discusses how bare base systems support national military strategy. It continues with a discussion of lessons learned and interoperability. It then reviews published literature concerning capabilities and limitations of bare base systems as they are managed today, and finally makes recommendations on the future of bare base management.


This task force report identifies technologies that improve fuel efficiency of the full range of weapons platforms, and assesses their operations, logistics, coat, and environmental impacts for a range or practical implementation scenarios.


This report outlines the DoD’s strategy to ensure that the armed forces will have the energy they require for 21st century military missions by developing a diverse portfolio of investments. This investments must balance near-term priorities for current operations and long-term energy solutions for the future. It also must concentrate its operational energy investments in the three areas: demand, supply, and future force planning.


This handbook provides a step-by-step approach to help energy managers design
and implement a program aimed at increasing energy-efficient behavior of employees at their facilities.


This USDOE website gives a general overview the location of geothermal energy sources in the United States, and three technologies (geothermal power plants, direct-use piped hot water, and geothermal heat pumps) that employ this energy source.


Federal agencies are required to procure energy-efficient products. FEMP produces purchasing specifications to help Federal buyers comply with these procurement requirements. This section outlines FEMP’s energy-efficient products program, including links to sites that summarize: Federal requirements, purchasing specifications, the product designation process, energy cost calculators, Standby Power Data Center (which lists Outlines products with low standby power), model language (to include in contracts involving the purchase and use of energy-using products), working group information (from the Federal Product Procurement Working Group [PPWG]), and additional resources.


This report summarizes the department of the Navy’s long-range energy vision, priorities, and goals.


This report gives an overall view of the Navy’s strategic approach to energy security, energy efficiency, and environmental stewardship.


This GAO report concludes that 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 report makes recommendations and lists selected initiatives.


This GAO report concludes that the DoD and the Army need to take additional action to improve the management and oversight of Logistics Civil Augmentation Program (LOGCAP) by: (1) creating teams of subject matter experts to review contract activities for economy and efficiency, and (2) coordinating contract activities between DoD components involved with using LOGCAP.

This document defines requirements to bed down an Operational Detachment Alpha (ODA), to include support, without any environmental constraints/restrictions.


The report communicates the US Marine Corps’ energy strategy. To align the Marine Corps expeditionary energy posture with the future force called for in the Marine Corps Vision and Strategy 2025, on the battlefield, the Marine Corps will: (1) procure and use more efficient equipment and upgrade legacy equipment, (2) increase its use of renewable energy though innovation and adaptation, and (3) change the way it thinks about energy – the warrior ethos must equate the efficient use of energy and water resources with increased combat effectiveness.


This report summarizes elementary energy and heating, ventilating, and air-conditioning (HVAC) assessments at eight US military locations in Afghanistan and one in Kuwait. It makes four recommendations to reduce energy consumption and improve indoor air quality for these and similar locations: (1) deliberately plan and design for energy conservation and IAQ, (2) reduce the electrical demand, (3) improve the building envelope, and (4) add a variety of renewable energy sources. The report also lists recommendations for follow-on R&D.


This PowerPoint presentation summarizes opportunities to reduce energy consumption in theater, by: (1) improving building envelope air tightness, (2) improving power generation efficiency, (3) replacing inefficient dining equipment, (4) installing efficient lighting, (5) using hot water heat recovery, (6) improving building insulation, (7) restricting occupant behavior, (8) using fewer fans/environmental control units (ECUs), (9) installing exterior shading and window tinting, and (10) instituting an information campaign to reduce user power demands.


This “Working Paper” gives an interim summary of the activities of the “Afghanistan Energy Reduction Program,” the goal of which is to implement energy efficiency, conservation, and renewable energy technology recommendations in the Afghanistan CJOA to significantly reduce energy demand and consumption. The document primarily background information and a summary of communications that give the program its impetus and direction.

This PowerPoint presentation attempts to determine and compare baseline planning factors for power and energy at the tactical and operational level. Such a baseline can be used to address power and energy requirements for the operations and support of deployed base camps, and to provide recommendations to reduce power and energy.


This interim report on the “22 Bunkers” Renewable Energy Technology Demonstration is based on information derived from monthly contractor reports (the contractor who installed the systems) — and not from either actual site visits, inspections, or other independently verifiable sources. Reported information is primarily qualitative (e.g., whether systems were operational); quantifiable results are unavailable due to sensor failures.

________. 26 July 2011. ERDC-CERL LOGCAP Visit to Rock Island Arsenal. Trip report. Champaign, IL: ERDC-CERL.

This document summarizes information gathered by ERDC-CERL researchers during a site visit to the Rock Island Arsenal, IL to interview LOGCAP personnel regarding LOGCAP tracking, processes, and requirements for: Fuel (focusing on the fuel required to run generators or other power producing equipment—opposed to delivering vehicle/aircraft fuel); Water; and Facility/base camp O&M.


This PowerPoint presentation illustrates the cracking and damage to tents insulated with spray foam, and describes the significant and costly problems that USFOR-A Environmental faces in properly disposing of spent foam-insulated tent material. Current disposal methods include expensive incineration or disposal in approved landfill. Neither option currently exists in Afghanistan.


This memorandum establishes Army policy regarding the establishment, sustainment, and transitioning of contingency bases.


This document briefly summarizes the Marine’s use of Experimental Forward Operating Base (ExFOB) gear as part of an effort to identify and evaluate energy efficient capabilities that can reduce risks to Marines and increase our combat effectiveness. Four solar powered technologies are currently being used in theater and initial reports from Marines on the ground have been positive. Based on this success, the Marine Corps is accelerating the deployment of ExFOB technologies to other Marine forces.

This report summarizes passive and active security assessment of a radio frequency/electronic warfare (RF/EW) and computer network security (CNS) of the Net Zero Plus (NZ+) Microgrid JCTD. No OS vulnerabilities were detected.
3 Summary

This work was undertaken to establish a greater understanding of the problems and solutions of operational energy in the context of contingency base camp development and management. Specific objectives of this work are to:

1. Collect data in Afghanistan to characterize contingency base energy use
2. Develop recommendations and implementation strategies (based on data collected from theater) for organic deployment of “low hanging fruit” energy solutions for FOB energy management
3. Suggest short and long-term solutions that address systemic contingency basing and operational energy challenges
4. Summarize policy recommendations that can help to reduce energy use in both the long and short term at FOBs.

In this stage of work, the ERDC-CERL Project Delivery Team (PDT) performed a literature review and identified existing studies that address expeditionary energy in the context of contingency basing.
## Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ACMP</td>
<td>Alaska Coastal Management Program</td>
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<tr>
<td>AEPI</td>
<td>Army Environmental Policy Institute</td>
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<td>AESIS</td>
<td>Army Energy Security Implementation Strategy</td>
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<td>AF</td>
<td>Air Force</td>
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<td>AFI</td>
<td>Air Force Instruction</td>
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<td>AFB</td>
<td>Air Force Base</td>
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<td>Air Force Civil Engineer Support Agency</td>
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<td>Air Force Instruction</td>
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<td>AFN</td>
<td>Air Force Network</td>
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<td>AMC</td>
<td>US Army Materiel Command</td>
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<td>AMP</td>
<td>Afghan Microgrid Project</td>
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<tr>
<td>AMSAA</td>
<td>US Army Materiel Systems Analysis Activity</td>
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<td>ANSI</td>
<td>American National Standards Institute</td>
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<td>ANSU</td>
<td>Afghanistan National Security University</td>
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<tr>
<td>AOR</td>
<td>Area of Responsibility</td>
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<tr>
<td>ASA(IEE)</td>
<td>Assistant Secretary of the Army (Installations, Energy and Environment)</td>
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<tr>
<td>ASD(OEPP)</td>
<td>Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs</td>
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<tr>
<td>AT&amp;L</td>
<td>Acquisition, Technology &amp; Logistics</td>
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<tr>
<td>BCDP</td>
<td>Camp Development Planning</td>
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<tr>
<td>CAAT</td>
<td>Collection and Analysis Team</td>
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<td>CALL</td>
<td>Center for Army Lessons Learned</td>
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<td>CNA</td>
<td>Center for Naval Analyses</td>
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<tr>
<td>CASCOM</td>
<td>US Army Combined Arms Support Command</td>
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<td>CBA</td>
<td>Capabilities-Based Assessment</td>
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<td>CEERD</td>
<td>US Army Corps of Engineers, Engineer Research and Development Center</td>
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<tr>
<td>CEO</td>
<td>Corporate Executive Officer</td>
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<td>CERL</td>
<td>Construction Engineering Research Laboratory</td>
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<td>CERP</td>
<td>Contracting Process for Prompt Payment</td>
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<td>CNA</td>
<td>Center for Naval Analyses</td>
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<td>CNAS</td>
<td>Center for a New American Security</td>
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<td>CNS</td>
<td>Computer Network Security</td>
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<td>Combat Operations Center</td>
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<td>DASN</td>
<td>Deputy Assistant Secretary of the Navy</td>
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<tr>
<td>DG</td>
<td>Distributed Generation</td>
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<td>DHW</td>
<td>Domestic Hot Water</td>
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<td>DLA</td>
<td>Defense Logistics Agency</td>
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<td>USDOE</td>
<td>US Department of Energy</td>
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<td>DOEPP</td>
<td>Director of Operational Energy Plans and Programs</td>
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<td>ECB</td>
<td>Engineering and Construction Bulletin</td>
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<td>E&amp;E</td>
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<td>EE</td>
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<td>Term</td>
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<tr>
<td>EMV</td>
<td>Evaluation, Measurement &amp; Verification</td>
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<td>EP</td>
<td>Engineering Pamphlet</td>
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<td>ERDC</td>
<td>Engineer Research and Development Center</td>
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<td>ETL</td>
<td>Engineer Technical Letter</td>
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<td>ExFOB</td>
<td>Experimental Forward Operating Base</td>
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<td>FBCF</td>
<td>Fully Burdened Cost of Fuel</td>
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<td>FM</td>
<td>Field Manual</td>
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<td>FOB</td>
<td>Forward Operating Base</td>
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<td>FY</td>
<td>Fiscal Year</td>
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<td>GAO</td>
<td>Government Accountability Office</td>
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<td>GE</td>
<td>General Engineering</td>
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<td>HQ</td>
<td>Headquarters</td>
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<td>HQMC</td>
<td>Headquarters, Marine Corps</td>
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<td>HQUSACE</td>
<td>Headquarters, US Army Corps of Engineers</td>
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<td>HT</td>
<td>High Temperature</td>
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<tr>
<td>HVAC</td>
<td>Heating, Ventilating, and Air-Conditioning</td>
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<td>IAQ</td>
<td>Indoor Air Quality</td>
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<td>ISAF</td>
<td>International Security Assistance Force</td>
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<tr>
<td>JCTD</td>
<td>Joint Capability Technology Demonstration</td>
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<tr>
<td>JIIM</td>
<td>Joint, Interagency, Intergovernmental, and Multinational</td>
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<tr>
<td>JOIOWC</td>
<td>Joint Information Operations Warfare Center</td>
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<td>JP</td>
<td>Joint Publication</td>
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<tr>
<td>KPP</td>
<td>Key Performance Parameter</td>
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<td>LCE</td>
<td>Logistics Combat Element</td>
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<td>Logistics Management Institute</td>
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<td>LOGCAP</td>
<td>Logistics Civil Augmentation Program</td>
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<td>MAESMO</td>
<td>Methodology &amp; Analysis for Energy Security in Military Operations</td>
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<td>MCWL</td>
<td>Marine Corps Warfighting Laboratory</td>
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<td>MEAT</td>
<td>Marine Energy Assessment Team</td>
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<td>MEP</td>
<td>Mobile Electric Power</td>
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<td>MEW</td>
<td>Ministry of Energy and Water</td>
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<td>MW</td>
<td>Megawatt</td>
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<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
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<td>NDIA</td>
<td>National Defense Industrial Association</td>
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<td>NG</td>
<td>Natural Gas</td>
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<td>NSN</td>
<td>National Supply Number</td>
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<td>NSSC</td>
<td>US Army Natick Soldier Systems Center</td>
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<td>NZ</td>
<td>Net Zero</td>
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<tr>
<td>O&amp;M</td>
<td>Operations and Maintenance</td>
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<td>OASA(I&amp;E)</td>
<td>Office of the Acting Deputy Assistant Secretary of the Army (Installations and Housing)</td>
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<td>OASD</td>
<td>Office of the Assistant Secretary of Defense</td>
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<td>ODA</td>
<td>Operational Detachment Alpha</td>
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<td>OEF</td>
<td>Operation Enduring Freedom</td>
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<td>OMB</td>
<td>Office of Management and Budget</td>
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<td>OPNAV</td>
<td>Office of the Chief of Naval Operations</td>
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<td>PAM</td>
<td>Pamphlet</td>
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<td>PAM</td>
<td>Pamphlet</td>
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<td>Term</td>
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<td>PDT</td>
<td>Project Delivery Team</td>
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<td>POR</td>
<td>Power on Reset</td>
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<td>RDTE</td>
<td>Research, Development, Test, and Evaluation</td>
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<td>R&amp;D</td>
<td>Research and Development</td>
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<td>RE</td>
<td>Renewable Energy</td>
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<td>RED</td>
<td>Renewable Energy Department</td>
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<td>RF/EW</td>
<td>Radio Frequency/Electronic Warfare</td>
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<td>S&amp;T</td>
<td>Science and Technology</td>
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<td>SAF/AQ</td>
<td>Assistant Secretary of the Air Force for Acquisition</td>
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<td>SAR</td>
<td>Same as Report</td>
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<td>SDD</td>
<td>Sustainable Design and Development</td>
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<td>SERDP</td>
<td>Strategic Environmental Research and Development Program</td>
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<td>SIL</td>
<td>System Integration Lab</td>
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<td>SME</td>
<td>Subject Matter Expert</td>
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<td>SOS</td>
<td>System of Systems</td>
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<td>SPF</td>
<td>Spray-Applied Polyurethane Foam</td>
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<td>SR</td>
<td>Special Report</td>
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<td>SRP</td>
<td>Strategy Research Project</td>
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<td>TFMD</td>
<td>Tactical Fuels Manager Defense</td>
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<td>TQG</td>
<td>Tactical Quiet Generator</td>
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<td>TR</td>
<td>Technical Report</td>
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<td>TRAC</td>
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<tr>
<td>TTPs</td>
<td>Tactics, Techniques, and Procedures</td>
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<tr>
<td>URL</td>
<td>Universal Resource Locator</td>
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<td>US</td>
<td>United States</td>
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<td>US Central Command</td>
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<td>US Pacific Command</td>
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<td>VCSA</td>
<td>US Army Vice Chief of Staff</td>
</tr>
<tr>
<td>WWW</td>
<td>World Wide Web</td>
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Since the beginning of Operation Iraqi Freedom/Operation Enduring Freedom, there have been countless studies, assessments, and reports that have made recommendations on how to improve energy use in the expeditionary environment. While there have been many studies focused on reducing fuel demand in theater, to date, there has been no comprehensive review of existing studies, and limited data is available to draw conclusions. To address this need, the Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs [ASD(OEPP)] tasked the US Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) with reviewing all currently available energy relevant studies, assessments, and lessons learned; identifying recommendations made in those reports, appropriately categorizing those recommendations, and assessing them through various criteria (impact, investment, etc.) to measure progress for a given recommendation or category of recommendations. In this initial stage of work, the Project Delivery Team (PDT) performed a literature review to identify the results of all existing studies available dealing with expeditionary energy in the context of contingency basing. This report contains an annotated bibliography of those sources.

15. SUBJECT TERMS
bibiography, energy management, forward operating bases (FOBs)