ERDC/CERL SR-11-8

Construction Engineering Research Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

Operational Energy Base Camp Studies

Annotated Bibliography

William T. Brown, III, Laura Curvey, Elon Zeigler, Stuart Foltz, Dahtzen Chu, John Vavrin, Garth Anderson, Kurt Kinnevan, Ghassan Al-Chaar, Samuel L. Hunter, and Franklin H. Holcomb

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Final Report

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Washington, DC 20314-1000

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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

Ackerman, Glenn H., and Geoffrey B. Shaw. November 2003. Installing Electric Meters at Navy Facilities: Benefits and Costs. Alexandria, VA: Center for Naval Analyses (CNA).

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."

Afghan Energy Information Center. 2010. Geothermal Energy.

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

Anderson, Garth. 11 May 2011. Sustainable Contingency Base Camp Operations and Management: Observations in Afghanistan 2011. PowerPoint presentation. New Orleans, LA: Environment, Energy Security, & Sustainability (E2S2) Conference.

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.

————. 17 June 2010. Sustainable Contingency Base Camp Operations. PowerPoint presentation. Champaign, IL: ERDC-CERL.

This PowerPoint presentation gives an introductory overview of base camps.

Anonymous. 10 September 2010. Automation of Tactical Accountability. Washington, DC: Office of the Assistant Secretary of the Army.

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.

————. 17 November 2008. Engineer Operations, Operation Iraqi Freedom August-September 2008: Initial Impressions Report.

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.

————. 24 November 2010. Operation Enduring Freedom Joint Engineer Operations August 2010: Initial Impressions Report.

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

————. 5 March 2009. NetZero Plus (NZ+) Joint Capability Technology Demonstration (JCTD). PowerPoint presentation.

This PowerPoint presentation gives an overview of the technologies and timeline with the NetZero Plus JCTD study.

———. February 2011. Assistant Secretary of the Army (Installations, Energy and Environment) (ASA[IEE]) Trip Report. Washington, DC: (ASA[IEE]).

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.

Arden, Wayne, and John Fox. June 2010. Producing and Using Biodiesel In Afghanistan: How The US Can Save Lives, Money, and Challenge The Opium Trade. White Paper. New York: Arden & Fox (Consultants).

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.

Army Capabilities Integration Center – Research, Development and Engineering Command – Deputy Chief of Staff. 1 April 2010. Power and Energy Strategy White Paper. White Paper. Fort Monroe, VA: Headquarters, US Army Training and Doctrine Command (HQ TRADOC).

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.

Army Environmental Policy Institute (AEPI). January 2011. Methodology & Analysis for Energy Security in Military Operations (MAESMO). Final Report. Washington, DC: AEPI.

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/combat 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.

Army Senior Energy Council, and the Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships. 13 January 2009. Army Energy Security Implementation Strategy. Washington, DC.

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).

Assistant Secretary of the Air Force for Acquisition (SAF/AQ). 24 November 2009. Air Force Acquisition & Technology Energy Plan 2010. Washington, DC: SAF/AQ.

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.

Assistant Secretary of the Air Force for Installations, Environment and Logistics (SAF/IE). 24 November 2009. Air Force Energy Plan 2010. Washington, DC: SAF/IE.

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.

Baer, Scott D. 18 March 2010. Operational Energy Metrics: Increasing Flexibility While Reducing Vulnerability. Strategy Research Project (SRP) Report. Carlisle, PA: US Army War College.

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."

Balling, Frederick O. 3 June 2009. Army Portable Water Treatment Units. Warren, MI: Tank Automotive Research Development and Engineering Center (TARDEC).

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

Barna, Lynette A., Keran J. Claffey, James S. Buska, and Jennifer L. Mercer. April 2011. Engineering assessment of big house at Summit Station, Greenland. ERDC/CRREL TR-11-10. Hanover, NH: Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory (ERDC/CRREL).

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.

Bartis, James T., and Lawrence Van Bibber. 2011. Alternative Fuels for Military Applications. Santa Monica, CA: RAND National Defense Research Institute.

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.

Bartis, James T., and Lawrence Van Bibber. 2011. Monograph. Alternative Fuels for Military Applications. (Limited Electronic Distribution Rights). Santa Monica, CA: Rand Corp.

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.

Birney, William T. 27 April 2007. Memorandum, Subject: Sustainable Design and Development Policy Update — Life Cycle Costs. Washington, DC: Office of the Acting Deputy Assistant Secretary of the Army (Installations and Housing) (OASA[I&E]).

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

Bolton, Chris. 01 February 2011. Afghan Microgrid Project. Fort Belvoir, VA: Office of the Project Manager Mobile Electric Power.

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

Boswell, Randy L. April 2007. The Impact of Renewable Energy Sources on Forward Operating Bases. White paper. Maxwell Air Force Base, AL: Air Command and Staff College, Air University.

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.

Bowes, Michael, and Barry Pifer. June 2010. Reducing Energy Footprint on the Battlefield. Alexandria, VA: Center for Naval Analyses (CNA).
This report assesses battlefield energy use and evaluates capabilities that might help the Marine Corps reduce fossil fuel use in an expeditionary environment.

Bowling, Curtis M., Eero Lavonen, and Jan Salestrand. March 2008. Environment Guidebook for Military Operations. Web publication of the Offices of the Director, Environmental Readiness & Safety, Office of the Deputy Under Secretary of Defense (Installations & Environment), US DoD; Director General, National Armaments Director MoD Finland; and Director Training & Procurement Swedish Armed Forces.

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

J. Stein, Seth W. Broadfoot, Brian Kamisato, Jerry Christensen, Charles Allen, John Etzel, Jeff Hurt, Daniel Patla, Joseph Van Winkle, Ravi Seam, Suresh Kikkeri, Tiffany Ferguson, and Michael Valerio. April 2011. Feasibility of Renewable Energy Technology at the Afghanistan National Security University: A Site-Specific Study Focused on Potential Renewable Energy Technologies in Northwest Kabul, Afghanistan. ERDC/CERL TR-11-12. Champaign, IL: ERDC-CERL.

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.

Budde, Kai H. 11 May 2011. German FOB Power Supply. PowerPoint presentation. Berlin, Germany: Bundeswehr, German Liaison Office for Defense Materiel USA/Canada.

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

Burke, Sharon E. 18 May 2011. Memorandum. Subject: "Energy in Expeditionary Operations" Summit Outcomes. MacDill Air Force Base (AFB), FL: Expeditionary Energy Summit, 5-6 May 2011.

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.

Burns. Melissa. 12 May 2011. Case Study: Expeditionary, Renewable Power and Water Purification to Enhance Security & Reliability While Reducing Environmental Impacts. (Limited distribution: "The following pages are not for redistribution without permission."). PowerPoint presentation. E2S2, New Orleans, LA. Ewing, NJ: Worldwide & Solar Technologies, Inc.

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.

Capabilities-Based Assessment (CBA) Guide, Version 3.0, TRADOC, 28 September 2009.

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.

Capstone Manufacturing LLC. TC Ceramic: Liquid Ceramic Insulation Coating. Web site. Seattle, WA: TC Industrial Ceramics.

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.

Catarious, David M., Jr., Craig Corl, William Kratz, E. Thomas Morehouse, Jr., Elizabeth McLaughlin Myrus, Cheryl B. Rosenblum, and Kevin Sweeney. May 2009. Powering America's Defense: Energy and the Risks to National Security. Alexandria, VA: CNA.

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.

CH2MHILL. October 2010. Theater Energy and Efficiency Plan. (FOUO). Final Report. Atlanta, GA: CH2MHILL.

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).

Chief of Naval Operations. 10 December 1992. Heating or Power Plant Fuel Selection Criteria. Office of the Chief of Naval Operations (OPNAV) Instruction 4100.6B. Washington, DC: Department of the Navy, Chief of Naval Operations.

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.

———. 12 April 1994. Energy Management. OPNAV Instruction 4100.5D. Washington, DC: Department of the Navy, Chief of Naval Operations.

This instruction issues policy, objectives, and goals, and assigns responsibilities for energy management for non-nuclear ships, aircraft, vehicles, and shore installations.

———. 2 June 2008. Peacetime Operating Stock and War Reserve Requirements and Stock for Petroleum Products. OPNAV Instruction 4020.15N. Washington, DC: Department of the Navy, Chief of Naval Operations.

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

———. 22 October 2001. Controlling and Accounting for Ground Fuels. OPNAV Instruction 4020.25B. Washington, DC: Department of the Navy, Chief of Naval Operations.

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

———. October 2010. A Navy Energy Vision for the 21st Century. Washington, DC: Office of the Chief of Naval Operations.

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.

Chiu, Yi-Wen, Brian Walseth, and Sangwon Suh. 2009. Water Embodied in Bioethanol in the United States. Environmental Science & Technology. Doi:10.1021/es8031067.

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.

Curtin, Deborah, Susan Bevelheimer, Gary Gerdes, Tom Hartranft, Roch Ducey, Stuart Foltz, Annette Stumpf, and Samuel Hunter. 2008. Sustainable, Full Spectrum Contingency Operations Gap Assessment. (Limited distribution: "Distribution authorized to the Department of Defense and US DoD contractors only; administrative or operational use; 1 August 2008. Other requests shall be referred to US Army Engineer Research and Development Center."). ERDC/CERL SR-08-13. Champaign, IL: ERDC-CERL.

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.

Defense Logistics Agency (DLA) 01 January 2010. Public Affairs Office. Fact Book Fiscal Year 2010. Fort Belvoir, VA: DLA Energy.

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.

———. Fuels Automated System (FAS): FAS Enterprise Server (FES) Functionalities. PowerPoint Presentation. July 6, 2004.

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

Deputy Chief of Staff, Operations, Plans and Requirements (AF/A3/5). 24 November 2009. Air Force Aviation Operations Energy Plan 2010. Washington, DC: AF/A3/5.

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.

DuPont. 2011. DuPont™ Tyvek®. Web site. Wilmington, DE: DuPont de Nemours and Company.

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.

Eady, David S., Steven B. Siegel, Kristin K. Stroup, Thayer M. Tomlinson, H. Anne Kaltenhauser, and Maria H. Rivera-Ramirez. 2006. Sustain the Mission Project: Resource Costing and Cost-Benefit Analysis. Arlington, VA: AEPI.

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

Eastin, Keith E., and Claude M. Bolton, Jr. 22 November 2006. Memorandum, Subject: Establishment of the Army Green Procurement Program. Washington, DC: Office of the Assistant Secretary of the Army.

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

Erickson, Zane. 11 May 2011. "The Use of Lightweight, Flexible, High Technology Materials to Reduce Noise, Provide Thermal Insulation and Fire Resistance to Tactical Shelters." Energy Security & Sustainability Symposium and Exhibition. National Defense Industrial Association (NDIA), New Orleans, LA

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 40to 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.

Expeditionary Logistics, Inc. 24 September 2010. Tactical Fuel and Energy Implementation Plan. AR 5-5 Study. Fort Lee, VA: US Army Sustainment Center of Excellence.

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.

Ferenczy, Adorjan. 10 August 2010. EMV 5-10 After Action Report.* (FOUO). PowerPoint presentation. Quantico, VA: Marine Corps Warfighting Laboratory (MCWL), Logistics Combat Element (LCE) Branch, Technology Division.

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.

Ferren, Bran, and Steven Huybrechts. July 2010. NG Green Energy Efficiency Study. White Paper. (Limited distribution: "This technical paper includes information that shall not be disclosed or duplicated.") Reston, VA: Applied Minds, Inc.

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

Fluor Intercontinental, Inc. 2011. Camp Phoenix Power and Fuel Study. Report. Greenville, SC: Fluor Intercontinental, Inc.

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.

Fritz, Oliver. 14 June 2010. Operational Energy Considerations. PowerPoint presentation. Washington, DC: Headquarters US Air Force (HQ USAF), Directorate of Strategic Planning HQ USAF/A8X.

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.

Fuentes, Gidget. 4 November 2010. Corps' Plan for Clean Water Downrange. Marine Corps News. Web page.

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.

Gibison, Tom. 10 February 2011. Minigrid Information Paper. White paper. Philadelphia, PA: US Army Corps of Engineers (USACE) Philadelphia District.

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.

Grana, Brian T. 2010. Incentivizing Sustained Department of Defense Energy Efficiency through a Modified Appropriations Framework. Master of Military Studies. Quantico, VA: US Marine Corps Command and Staff College Marine Corps University.

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.

Hayward, Steven F. Mark Muro, Ted Nordhaus, and Michael Shellenberger. October 2010. Post-Partisan Power: How a Limited and Direct Approach to Energy Innovation Can Deliver Clean, Cheap Energy, Economic Productivity and National Prosperity. Washington, DC: The American Enterprise Institute and the Brookings Institution; Oakland, CA: Breakthrough Institute.

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.

Headquarters Air Force Civil Engineer Support Agency (HQ AFCESA). 2010. External Foam Insulation of Temporary Structures. Engineering Technical Letter (ETL) 10-6. Tyndall AFB, FL: AFCESA/Corporate Executive Officer (CEO) .

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.

Headquarters, Department of the Army (HQDA). 10 May 2005. Tactical Land-Based Water Resources Management. Army Regulation (AR) 700-136. Washington, DC: HQDA.

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.

———. April 2009. FM 3-34 Engineering Operations. Washington, DC: HQDA.

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.

———. February 2009. FM 3-34-22 Engineer Operations Brigade Combat Team and Below. Washington, DC: HQDA.

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.

———. July 2003. Field Manual (FM) 3-05.230, Special Forces Base Camp Operations. (Distribution authorized to US Government agencies only.) Washington, DC: HQDA.

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.

———. March 1989. FM 5-116 Engineer Operations: Echelons Above Corps. Washington, DC: HQDA.

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).

Headquarters, Departments of the Army, Navy, and Air Force. 1 May 2010. Sanitary Control and Surveillance of Field Water Supplies. Sanitary Control and Surveillance of Field Water Supplies. TB MED 577/ NAVMED P-5010-10/AFMAN 48-138_IP. Washington, DC: Departments of the Army, Navy, and Air Farce.

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.

Headquarters, US Army Corps of Engineers (HQUSACE). 19 January 2009. Base Camp Development in the Theater of Operations. Engineering Pamphlet (EP) 1105-3-1. Washington, DC: HQUSACE.

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.

———. 27 May 2010. External Spray-Applied Polyurethane Foam (SPF) Insulation on Tents and Temporary Structures in Contingency Locations. Engineering and Construction Bulletin (ECB) No. 2010-11. Washington, DC: HQUSACE, CECW-CE.

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.

———. December 2008. General Engineering. FM 3-34.400. Washington, DC: HQUSACE.

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.

Headquarters, US Army Training and Doctrine Command (HQ TRADOC). 07 December 2009. Concept Capability Plan for Army Base Camps in Full Spectrum Operation for the Future Modular Force 2015-2024, 07 December 2009. TRADOC PAM 525-7-7. Fort Monroe, VA: HQ TRADOC.

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 (JIIM) environment.

Hodge, Harold. 18 February 2011. Energy Efficient Structures. White Paper. Natick, MA: US Army Natick Soldier Systems Center (NSSC) .

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

International Code Council (ICC). 2006. 2006 IECC Commercial Building Envelope Prescriptive Requirements. Falls Church, VA: ICC.

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).

Jantzer, Andrew L., and Gary L. Gerdes. September 2004. Base Camp Utility Technology Matrix. (Limited distribution: "Distribution authorized to US Government agencies only; Administrative or Operational Use; 1 November 2005. Other requests shall be referred to ERDC-CERL."). ERDC/CERL TR-05-34. Champaign, IL: ERDC/CERL.

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.

Jelen, Michael J. 16 June 2010. Alternative Energy as an Engagement Opportunity in the USPACOM AOR. PowerPoint presentation. Palau Islands: US Pacific Command (USPACOM) .

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

John, Ashley, and Kris Osborn. 2010. From the Source to Consumption— Operation H2O is Moving Full Steam Ahead. Army AL&T. July-September 2010.

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.

Joint Chiefs of Staff. 09 December 2010, Joint Bulk Petroleum and Water Doctrine. JP 4-03, 23 May 2003 (rev. 09 December 2010). Washington, DC: Office of the Joint Chiefs of Staff.

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

Keller, Brian. 26 January 2010. Man Portable. PowerPoint presentation. New Orleans, LA: US Marine Corps (USMC) Expeditionary Power & Energy Symposium, 26 January 2010.

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.

Kirk, Scott. 19 July 2011. Tactical Fuel Manager Defense, Tactical Fuels Advanced Support Specialist. Telephone interview by Laura Curvey.

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.

Kuntz, COL Gordon D., and John Fittipaldi. March 2007. Use of Renewable Energy in Contingency Operations. AEPI and US Army War College (USAWC) Research Paper. Arlington, VA: AEPI.

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.

Larvick, Jon A. 29 March 2010. Improving Energy Efficiency in a Deployed Environment On-Site Assessment. Washington, DC: SAF/IE.

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

Lightfoot, Rocky A. 1 February 2011. Prime Power Ideas for Energy Reduction. (FOUO). Kabul, Afghanistan: Chief of Basing & Facilities, USFOR-A.

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

Lueken, Roger. 14 June 2010. Geothermal Power: Improving Sustainability at Forward Operating Bases. National Defense Industrial Association (NDIA) E2S2 Energy Summit Conference, Denver CO. PowerPoint presentation. McLean, VA: LMI Institute.

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.

Maybee, Sean C. 2008. National Security and Global Climate Change. Joint Force Quarterly. 49(2dQ):98-102.

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

McLeary, Paul. May 2011. Renewable Energy Power Surge. Defense Technology International.

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.

Medici, Andy. 25 January 2011. US Navy Rips Rand Corp. Report on Biofuels. Defense-News: A Gannett Company.

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.

Meredith, Steve. 3 May 2011. Lightening the Load: Defining the Path Forward. PowerPoint presentation. Fort Benning, GA: Maneuver Center of Excellence.

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.

Military Suppliers & News. 2011. The Kärcher Futuretech Expeditionary Water Packaging System. Web page.

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."

Moore, T. C. 26 January 2010. Marine Energy Assessment Team Afghanistan Assessment Outbrief. Kabul, Afghanistan: Marine Energy Assessment Team (MEAT) .

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

Moore, T. C., B. H. Newell, J. L. Alderman, R. Dickson, D. Nolan, and J. W. Barnett. December 2009. Report of the Afghanistan Marine Energy Assessment Team December 2009. Unpublished Report. Kabul, Afghanistan: MEAT.

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.

Munroe, John. 10 June 2010. System of Systems (SOS) Base Camp: LOE 1 Power & Energy Management. (FOUO). PowerPoint presentation.

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.

———. Energy & Water Efficiency Solutions for Force Provider Equipped Base Camps. Natick, MA: US Army Natick Soldier Systems Center (NSSC), US Army Product Manager Force Sustainment Systems.

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).

———. 2011. Baseline Metrics for 50- and 150-Man Camps. Excel spreadsheet. Natick, MA: US Army Natick Soldier Systems Center (NSSC), US Army Product Manager Force Sustainment Systems.

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).

Nathman, John. 1 September 2009. Powering America's Defense: Energy and the Risks to National Security. PowerPoint presentation. Alexandria, VA: CNA.

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

———. September 2009. Powering America's Defense: Energy and the Risks to National Security, A presentation from the 2009 Topical Symposium: Energy Security: A Global Challenge, 29-30 September 2009. Alexandria, VA: CNA.

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

Newell, Brandon. 1 October 2010. HOMER as a Marine Corps Pre-Deployment Tool To Evaluate Power Solutions. PowerPoint presentation. Monterey, CA: Naval Postgraduate School.

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.

———. 24 May 2011. USMC Experimental Forward Operating Base Process: Accelerating COTs/R&D to POR and TTPs. (FOUO). PowerPoint presentation. 29 Palms, CA: Expeditionary Energy Office (E^2O) .

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."

———. May 2011. USMC Expeditionary Energy. PowerPoint presentation. Washington, DC: Headquarters, US Marine Corps, E^2O.

This PowerPoint presentation describes the mission of the E^2O, 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.

Noblis. 3 August 2010. Sustainable Forward Operating Bases. Final Report. Falls Church, VA: Noblis.

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

Nwafor, Vincent C., T. E. Harrell, Jr., and P. Miller. 1 May 2010. "Fuel Support at Contingency Operating Base Speicher." Army Sustainment. 42(3) May-June 2010.

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.

Office of the Deputy Under Secretary of Defense (Installations and Environment). May 2010. DoD Annual Energy Management Report: Fiscal year 2009.

This report describes the DoD's FY09 facilities energy management activities and operations, and its progress in implementing the requirements of the following Executive Orders and Acts of Congress: Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" 24 January 2007; Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance" (5 October 2009); Public Law (PL) 109-58, "Energy Policy Act of 2005" (8 August 2005); PL 109-264, "John Warner National Defense Authorization Act for Fiscal Year 2007; and PL 110-140, "Energy Independence and Security Act of 2007" (19 December 2007).

Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. February 2008. Report of the Defense Science Board Task Force on DoD Energy Strategy: "More Fight – Less Fuel. Final Report. Washington, DC: Defense Science Board.

This report summarizes the work of the US Defense Science Board (DSB) Task Force on DoD Energy Strategy, which met from May 2006 to March 2007. This report addresses the Department's energy posture by improving the effectiveness of tactical systems, managing risk to critical infrastructure and installations, crosscutting issues and findings, and making general recommendations.

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.

Petraeus, GEN David. 7 June 2011. Memorandum, Subject: Supporting the Mission with Operational Energy. Kabul, Afghanistan: Headquarters, US Forces, Afghanistan.

This memorandum expresses the Headquarters, US Forces, Afghanistan policy directive to reduce fuel use in theater.

Pew Charitable Trusts, The. 2010. Reenergizing America's Defense: How the Armed Forces Are Stepping Forward to Combat Climate Change and Improve the US Energy Posture. Washington, DC: The Pew Charitable Trusts.

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

Proebstel, Don, and Clint Wheelock. 2011. Renewable Energy for Military Applications: Solar, Wind, Biomass, Geothermal, Hydrokinetic Energy, Biofuels and Synfuels, Fuel Cells, Microgrids, Smart Meters, and Energy Efficiency. Executive Summary (of a larger report available for purchase). Boulder CO: Pike Research.

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.

Rann, Stephan. 31 January 2011. Operational Energy: Energy Reduction Efforts. PowerPoint presentation. Washington, DC: Assistant Secretary of the Army (Installations, Energy, & Environment) .

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.

Richard, Paul. 25 April 2007. Mobile Electric Power for Today and Tomorrow. PowerPoint presentation. San Diego, CA: Joint Service Power Expo, 25 April 2007.

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

Robyn, Dorothy. 10 May 2011. DoD Installations, Energy and the Environment: An Update. Energy Security & Sustainability Symposium and Exhibition. National Defense Industrial Association (NDIQ), New Orleans, LA.

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

Ruark, Robert, BGen. 27 January 2010. Forward Operating Base Sustainment. PowerPoint presentation. New Orleans, LA: USMC Expeditionary Power & Energy Symposium.

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

Saba, D. S., M. E. Najaf, A. M. Musazai, and S. A. Taraki. 2004. Geothermal energy in Afghanistan: Prospects and potential. Prepared for Center on International Cooperation, New York, USA, and Afghanistan Center for Policy and Development Studies, Kabul, Afghanistan,

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.

Secretary of the Air Force. 16 July 2009. Energy Management. Air Force Instruction 90-1701. Washington, DC: SAF/IE.

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.

Shaffer, Alan R. 3 March 2009. Before the Subcommittee on Readiness, of the House Armed Services Committee. Statement Testimony.

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.

Shields, Eric B., Robert A. Skelding, Alex F. Askari, and Evan T. Rule. August 2010. Testing and Evaluation of Technologies at the Experimental Forward Operating Base Phase IV. (Distribution authorized to US Government agencies and their contractors only). Technical Report NSWCCD-61-TR–2010/12. West Bethesda, MD: Naval Surface Warfare Center Carderock Division.

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]).

Spiller, John. 9 May 2011. Quick Reaction Fund – Monthly Project Status Report. Fort Belvoir, VA: Mobile Electric Power.

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

Stewart, Dan, and Ken Eickmann. 25 March 2010. Air Force Strategic Energy Forum 2010 Report. Washington, DC: Assistant Secretary of the Air Force for Installations, Environment and Logistics (SAF/IE) .

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.

Trautmann, W. D. Jr. April 2006. Designing Bare Base Systems for Logistics Efficiency in the Joint Operational Environment. Maxwell AFB, AL: Air Command and Staff College.

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.

Truly, Richard H., and Alvin L. Alm. May 2001. Report of the Defense Science Board on More Capable Warfighting through Reduced Fuel Burden. Final Report. Washington, DC: Defense Science Board.

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.

US Department of Defense (DoD). May 2011. Energy for the Warfighter: Operational Energy Strategy. Final Report. Washington, DC: Assistant Secretary of Defense for Operational Energy, Plans & Programs.

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.

US Department of Energy (USDOE). 2007. Creating an energy awareness program: A handbook For Federal Energy Managers. Washington, DC: USDOE.

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.

———. 2008. Geothermal Technologies Program: Geothermal Basics, USDOE, Energy Efficiency and Renewable Energy, Website.

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.

———. Office of Energy Efficiency and Renewable Energy, Federal Energy Management Program (FEMP). 18 July 2011. Procuring Energy-Efficient Products. Website. Accessed 2 August 2011.

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.

US Department of the Navy. 22 December 2010. Department of the Navy's Energy Program for Security and Independence. Washington, DC: US Department of the Navy, Deputy Assistant Secretary of the Navy (DASN) Energy Office.

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

———. October 2009. Naval Energy: A Strategic Approach. Washington, DC: US Department of the Navy, DASN Energy Office.

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

US Government Accountability Office (GAO). February 2009. Defense Management: DoD Needs To Increase Attention on Fuel Demand Management at Forward-Deployed Locations. Washington, DC: GAO.

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.

———. March 2005. Defense Logistics: High-Level DoD Coordination Is Needed To Further Improve the Management of the Army's LOGCAP Contract. Washington, DC: GAO.

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.

US Joint Forces Command (USJFCOM). December 2010. Encampment Requirements Document. White Paper. Norfolk, VA: USJFCOM.

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

USMC Expeditionary Energy Office (E^2O). 9 March 2011. United States Marine Corps Expeditionary Energy Strategy and Implementations Plan. Washington, DC: Headquarters, US Marine Corps, E^2O.

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.

Vavrin, John L. 13 November 2009. Energy Reduction and Indoor Air Quality (IAQ) Improvements in US Facilities. White Paper. Champaign, IL: Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) .

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.

———. 2010. Energy Reduction Opportunities and Indoor Air Quality Improvements in US Facilities in an Expeditionary Theater: Afghanistan and Kuwait. PowerPoint presentation. Champaign, IL: Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL),

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.

———. 12 March 2011. The Giffords Initiative: Afghanistan energy reduction program,

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.

———. 16 June 2010. Power and Energy Considerations at Forward Operating Bases (FOBs). PowerPoint presentation. Champaign, IL: ERDC-CERL.

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.

———. 18 August 2010. Interim Report on the "22 Bunkers" Renewable Energy Technology Demonstration. Champaign, IL: ERDC-CERL.

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.

———. 27 May 2010. USFOR-A Spray-Foam Tents: Discontinued. Provided by USFOR-A Joint Engineering, January 2011.

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.

Westphal, Joseph W., and Peter W. Chiarelli. 1 June 2011. Memorandum, subject: Army Policy for Establishing, Managing, and Transitioning Contingency Bases. Washington, DC: Office of the Undersecretary of the Army.

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

Wolf, Greg, Lt. 24 January 2011. Briefing Card: 3/5 and Marine Corps Expeditionary Energy. Arlington, VA: Headquarters, Marine Corps (HQMC) Public Affairs Division (DivPA) .

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

Yniguez, Julian, Steve Heacox, Mark Robertson, and Justin Willmann. March 2011. Net Zero Plus Microgrid Technology Joint Capability Technology Demonstration: Passive and Active Assessment Report. (FOUO). San Antonio, TX: Joint Information Operations Warfare Center Operational Technologies Integration Vulnerability Assessment Division (JIOWC/J99) .

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

Term	Definition
ACMP	Alaska Coastal Management Program
AEPI	Army Environmental Policy Institute
AESIS	Army Energy Security Implementation Strategy
AF	Air Force
AFI	Air Force Instruction
AFB	Air Force Base
AFCESA	Air Force Civil Engineer Support Agency
AFI	Air Force Instruction
AFN	Air Force Network
AMC	US Army Materiel Command
AMP	Afghan Microgrid Project
AMSAA	US Army Materiel Systems Analysis Activity
ANSI	American National Standards Institute
ANSU	Afghanistan National Security University
AOR	Area of Responsibility
ASA(IEE)	Assistant Secretary of the Army (Installations, Energy and Environment)
ASD(OEPP)	Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs
AT&L	Acquisition, Technology & Logistics
BCDP	Camp Development Planning
CAAT	Collection and Analysis Team
CALL	Center for Army Lessons Learned
CNA	Center for Naval Analyses
CASCOM	US Army Combined Arms Support Command
CBA	Capabilities-Based Assessment
CEERD	US Army Corps of Engineers, Engineer Research and Development Center
CEO	Corporate Executive Officer
CERL	Construction Engineering Research Laboratory
CERP	Contracting Process for Prompt Payment
CNA	Center for Naval Analyses
CNAS	Center for a New American Security
CNS	Computer Network Security
COC	Combat Operations Center
DASN	Deputy Assistant Secretary of the Navy
DG	Distributed Generation
DHW	Domestic Hot Water
DLA	Defense Logistics Agency
USDOE	US Department of Energy
DOEPP	Director of Operational Energy Plans and Programs
ECB	Engineering and Construction Bulletin
E&E	Energy and Efficiency
EE	Energy Efficiency

Term	Definition
EMV	Evaluation, Measurement & Verification
EP	Engineering Pamphlet
ERDC	Engineer Research and Development Center
ETL	Engineer Technical Letter
ExFOB	Experimental Forward Operating Base
FBCF	Fully Burdened Cost of Fuel
FM	Field Manual
FOB	Forward Operating Base
FY	Fiscal Year
GAO	Government Accountability Office
GE	General Engineering
HQ	Headquarters
HQMC	Headquarters, Marine Corps
HQUSACE	Headquarters, US Army Corps of Engineers
HT	High Temperature
HVAC	Heating, Ventilating, and Air-Conditioning
IAQ	Indoor Air Quality
ISAF	International Security Assistance Force
JCTD	Joint Capability Technology Demonstration
JIIM	Joint, Interagency, Intergovernmental, and Multinational
JIOWC	Joint Information Operations Warfare Center
JP	Joint Publication
KPP	Key Performance Parameter
LCE	Logistics Combat Element
LMI	Logistics Management Institute
LOGCAP	Logistics Civil Augmentation Program
MAESMO	Methodology & Analysis for Energy Security in Military Operations
MCWL	Marine Corps Warfighting Laboratory
MEAT	Marine Energy Assessment Team
MEP	Mobile Electric Power
MEW	Ministry of Energy and Water
MW	Megawatt
NATO	North Atlantic Treaty Organization
NDIA	National Defense Industrial Association
NG	Natural Gas
NSN	National Supply Number
NSSC	US Army Natick Soldier Systems Center
NZ	Net Zero
O&M	Operations and Maintenance
OASA(I&E)	Office of the Acting Deputy Assistant Secretary of the Army (Installations and Housing)
OASD	Office of the Assistant Secretary of Defense
ODA	Operational Detachment Alpha
OEF	Operation Enduring Freedom
OMB	Office of Management and Budget
OPNAV	Office of the Chief of Naval Operations
PAM	Pamphlet

Term	Definition
PDT	Project Delivery Team
POR	Power on Reset
RDTE	Research, Development, Test, and Evaluation
R&D	Research and Development
RE	Renewable Energy
RED	Renewable Energy Department
RF/EW	Radio Frequency/Electronic Warfare
S&T	Science and Technology
SAF/AQ	Assistant Secretary of the Air Force for Acquisition
SAR	Same as Report
SDD	Sustainable Design and Development
SERDP	Strategic Environmental Research and Development Program
SIL	System Integration Lab
SME	Subject Matter Expert
SOS	System of Systems
SPF	Spray-Applied Polyurethane Foam
SR	Special Report
SRP	Strategy Research Project
TFMD	Tactical Fuels Manager Defense
TQG	Tactical Quiet Generator
TR	Technical Report
TRAC	TRADOC Analysis Center
TRADOC	US Army Training and Doctrine Command
TTPs	Tactics, Techniques, and Procedures
URL	Universal Resource Locator
US	United States
USA	United States of America
USACE	US Army Corps of Engineers
USAF	US Air Force
USAID	US Agency for International Development
USAWC	US Army War College
USCENTCOM	US Central Command
USFOR-A	US Forces – Afghanistan (USFOR-A)
USJFCOM	US Joint Forces Command
USMC	US Marine Corps
USPACOM	US Pacific Command
VCSA	US Army Vice Chief of Staff
WWW	World Wide Web

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14. 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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bibliography, energy management, forward operating bases (FOBs)

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