

Fiscal Year 2016 Operational Energy Annual Report



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Introduction

This report fulfills the Department of Defense (DoD) Operational Energy Annual Report requirement in title 10, United States Code (U.S.C.), section 2925(b), for Fiscal Year (FY) 2016. The report includes information on operational energy demands, progress in implementing the *2016 Operational Energy Strategy*, support to contingency operations, and investments in alternative fuels. By statute, operational energy is defined as “energy required for training, moving, and sustaining military forces and weapons platforms for military operations,” and includes energy used by ships, aircraft, combat vehicles, and tactical power generators.

Comprising approximately 57 percent of total Federal energy consumption, the Department consumed almost 86 million barrels of fuel in FY 2016 to power ships, aircraft, combat vehicles, and contingency bases.¹ To minimize the risks associated with moving fuel over long distances and to maximize value, the Department purchases fuel close to the point of use. As a result, over 54 percent of fuel was purchased outside of the United States in FY 2016. Notwithstanding unforeseen changes in operational tempo, the Department estimates it will use slightly fewer barrels of fuel in FY 2017 than in the previous Fiscal Year. In addition to changes in operations tempo, this decrease reflects continued improvements in equipment on air, land, and sea.

A significant highlight of 2016 was the release of the *2016 Operational Energy Strategy*. While the Department was well served by the initial 2011 strategy, significant improvements in our own analytical processes and a changing operational environment led the Department to revise our overall strategy guiding operational energy objectives and supporting initiatives. Moving beyond input-focused initiatives linked to energy demand and diversifying supply, the Department is now focused on three objectives: increasing future warfighting capability, identifying and reducing logistics and operational risk, and enhancing mission effectiveness of our current force.² The revised strategy also identified 15 targets associated with implementing these three objectives between FY 2016 and 2018. Offices of Primary Responsibility (OPR) created work groups to further refine the targets, establish work plans, and take actions against specific, time-bound milestones. The OPRs for

*Influences on the
2016 Operational Energy Strategy*

- Rebalance to the Pacific
- Improved Analytical Capability
- Continued Support of Global Operations
- Increasing Risks to Operational Energy

¹ Page 16 and 17 of 2015 DoD Annual Energy Management Report available at <http://www.acq.osd.mil/eie/Downloads/IE/FY%202015%20AEMR.pdf>

² The 2016 Operational Energy Strategy can be found at http://www.acq.osd.mil/eie/Downloads/OE/2016%20OE%20Strategy_WEBd.pdf

targets assessed in FY 2016 then reported progress to the Defense Operational Energy Board (DOEB) co-chaired by the Assistant Secretary of Defense for Energy, Installations, and Environment (ASD(EI&E)) and the Director for Logistics, Joint Staff J4.

Implementing the 2016 Operational Energy Strategy

The 2016 *Operational Energy Strategy* not only directed the substantive focus of our operational energy efforts toward capability, risk, and mission effectiveness, but also ensured that supporting targets were defined and measurable. Of the 15 targets in the strategy, six were identified for completion in FY 2016 and summarized in Table 1.

Table 1: 2016 OE Strategy Targets for FY 2016

Objectives	Goals	Targets	Status
Increase Future Capability	Institutionalize Energy Supportability Analysis in Capability Development	Ensure all acquisition programs that use operational energy and are designated as JROC Interest Items by the Joint Staff have an ESA-informed eKPP	Complete
Identify and Reduce Risks	Improve Energy Supportability of Concepts of Operations	Identify Concept of Operations (CONOPS) with OE implications	Complete
	Diversify Energy Supplies to Reduce Risk	Review Department capability to test and certify drop in alternative fuels in pace with emerging technologies	Complete
		Assess opportunities and risks related to expanded use of commercial products and infrastructure	Incomplete
Enhance Current Mission Effectiveness	Upgrade Current Equipment to Improve Energy Use	Establish recurrent assessment of opportunities to increase energy supportability of current equipment with extensive remaining service lives	Complete
	Improve Energy Behavior	Assess improvement needed in energy information systems to increase supply chain visibility	Complete

The one incomplete target will be finished by the spring of 2017 and documented in the FY 2017 Operational Energy Annual Report. Below are specific details on each FY 2016 target.

Increase Future Capability

Ensure all acquisition programs that use operational energy and are designated as Joint Requirements Oversight Council (JROC) Interest Items by the Joint Staff have an Energy Supportability Analysis (ESA)-informed Energy Key Performance Parameter (eKPP).

Background. Driven by the increasing fuel needs of our forces and the equally growing threats to the assured delivery of that fuel, statute and policy directed the use of an Energy Key

Performance Parameter (eKPP), informed by an Energy Supportability Analysis (ESA).³ The ESA uses a realistic scenario- based analysis to determine the ability of the Joint force to sustain a unit of maneuver (not just an individual platform) performing its combat mission. This analysis must be stressful, of sufficient duration to require at least one refueling operation, allow for adversary attacks on our logistical tail, include logistic constraints (e.g., choke points), and account for the attrition (combat and noncombat) of both combat and support forces. The analysis uses current or projected force structure, planning factors, Concepts of Operation (CONOPS), and Tactics, Techniques, and Procedures (TTPs), to determine the supply chain's capacity to support new capabilities. In turn, the ESA informs the eKPP, which is a mandatory level performance required of the new system. The eKPP optimizes fuel and electric power demand in capability solutions as it directly affects the burden on the force to provide and protect critical energy supplies. Overall, the eKPP reflects whether a platform can successfully perform its mission as intended and whether the platform is sustainable using planned force structure, CONOPS, and TTPs.

In some cases, as older programs migrate to the Joint Capabilities Integration Development System (JCIDS) process, the Department is requiring the Services to conduct an ESA. While an ESA will not change the platform in question, the knowledge gained from the ESA may inform other operational energy efforts, such as changes to logistics assets and infrastructure or concepts of employment.

While mandatory for all programs, the FY 2016 target focuses on JROC interest items, which are large Acquisition Category I programs and any other programs of interest to senior leadership. A separate target builds on these larger, high interest programs and mandates that by FY 2018, the Department use an ESA-informed eKPP on all programs that consume operational energy and were initiated after FY 2016.

Assessment. The Defense Operational Energy Board assessed this target as complete. There were 27 JROC-interest programs in FY 2016. 14 had ESA-informed eKPPs while the remaining 13 had eKPP waivers by the Joint Staff, Director of Logistics. Programs with eKPPs included the Marine Corps CH-53K King Stallion helicopter, the Army's M109 family of vehicles, Armored Multi-purpose Vehicle, Amphibious Ship Replacement, and the Navy's MQ-8C Fire Scout unmanned helicopter. Most eKPP waivers were granted to Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) programs.

³ Use of an energy supportability analysis is addressed on page 745 of the Joint Explanatory Statement to the FY 2015 National Defense Authorization Act. The Joint Capabilities Integration and Development System is found at: https://dap.dau.mil/policy/Documents/2015/JCIDS_Manual_with_errata_through_20151218.pdf

Identify and Reduce Risks

Identify Concept of Operations (CONOPs) with OE implications.

Background. The evolving operational environment is often characterized by anti-access and area denial (A2/AD) threats to U.S. forces entering and maneuvering within theaters of conflict. In response, the Services are developing CONOPs, which are broad statements of how a commander would overcome these threats and accomplish the mission. These CONOPs are used to refine more long-term capability requirements, as well as inform near-term decisions on posture, training, and risk.

Service CONOPs often envision a form of force dispersal to reduce the efficacy of adversary attack by spreading forces without degrading combat power. However, the dispersal of forces directly increases the demand for logistics generally and operational energy in particular. While major operating bases in a theater allow for logistical economies of scale, more numerous, smaller bases increase the demand for logistics capacity, personnel, fuel support equipment and infrastructure, and fuel itself.

This target is intended to ensure that emerging operational concepts consider the likely constraints imposed by the availability of operational energy. In some cases, a concept might be modified to account for these constraints. In other cases, the Department may need to consider increased logistics assets or infrastructure to support the concept. As these CONOPs consider a more comprehensive view of the effects of operational energy on mission effectiveness, any resulting decisions associated with force structure, new capabilities, posture, and other issues will be better matched to the likely operational environment.

Assessment. The Office of the Deputy Assistant Secretary of Defense for Operational Energy (ODASD(OE)) reviewed four Service CONOPs (*Army Operating Concept*, Army, 2014; *A Cooperative Strategy for 21st Century Seapower*, Navy, 2015; *Air Superiority 2030*, Air Force, 2016; *The Marine Corps Operating Concept*, USMC, 2016) and confirmed that each concept had significant implications for operational energy.⁴ The DOEB assessed this target as complete and the results of this analysis will be used to inform Service assessments of energy supportability and OE vulnerabilities in each of their respective CONOPS by the end of FY 2017.

⁴ CONOPs can be found at:

<http://www.tradoc.army.mil/tpubs/pams/tp525-3-1.pdf>

<http://www.navy.mil/local/maritime/150227-CS21R-Final.pdf>

<http://www.af.mil/Portals/1/documents/airpower/Air%20Superiority%202030%20Flight%20Plan.pdf>

<http://www.mccdc.marines.mil/Portals/172/Docs/MCCDC/young/MCCDC->

[YH/document/final/Marine%20Corps%20Operating%20Concept%20Sept%202016.pdf?ver=2016-09-28-083439-483](http://www.mccdc.marines.mil/Portals/172/Docs/MCCDC/young/MCCDC-YH/document/final/Marine%20Corps%20Operating%20Concept%20Sept%202016.pdf?ver=2016-09-28-083439-483)

*Review Department capability to test and certify
drop-in alternative fuels in pace with emerging technologies.*

Background. While DoD is a large user of military-specification fuels, the broader commercial market is far larger and drives the specifications and make-up of liquid fuels consumed around the globe. As a result, it is increasingly important for the Department to understand the technical characteristics of fuels that have been, or will soon be, approved and available for commercial use (e.g., by commercial airlines).

Assessment. The DOEB assessed this target as complete. Defense Logistics Agency (DLA) Energy confirmed that each Service has the capability to support the testing and certification of current and future alternative fuels, through employing experts and physical assets within the Department's laboratory system and through contractual partnerships with commercial entities. The Army, Navy, and Air Force have completed testing of alternative jet fuels produced through several pathways, as described in Appendix B. To minimize the risk of fuels from new pathways entering the commercial supply chain before the Services complete testing, the Tri-Services Petroleum, Oils, and Lubricants Users Group will present an updated testing and certification roadmap for new pathways in 2017.

*Assess opportunities and risk related to expanded use of
commercial petroleum products and infrastructure.*

Background. In accordance with the Department's policy to increase standardization, flexibility, and interoperability, the Department is assessing the use of commercial specification fuels and infrastructure to reduce cost and gain access to a broader network of suppliers to develop a more robust supply chain with less risk. To understand any risks and opportunities associated with this approach, DLA Energy first evaluated the commercial jet fuel supply chain within the Continental United States (CONUS). Next, DLA Energy initiated a study of the requirements of fuel additization in deployed environments Outside the Continental United States (OCONUS).

While the initial study identified additional opportunities for commercial fuels and infrastructure use in CONUS, DLA Energy did not sufficiently address OCONUS opportunities. To meet the intent of the target, a more detailed risk assessment is required to identify potential threats to CONUS and OCONUS supply chains and develop mitigations for these risks.

Assessment. While DLA Energy identified opportunities for commercial fuel and infrastructure use in CONUS, OCONUS risks were not evaluated. As a result, the DOEB assessed this target as incomplete. To complete this target, DLA Energy will review the risks and opportunities associated with the expanded use of commercial fuels and infrastructure to support OCONUS operations by spring 2017.

Enhance Current Mission Effectiveness

Establish a recurring assessment of opportunities to increase the energy supportability of current equipment with extensive remaining service lives.

Background. After the Department procures a large weapon system, these platforms may be in service for decades. Even if state of the art when initially fielded, components such as engines, navigation systems, materials, power storage and management systems, and other items can eventually become constraints on the capability and supportability of the overall platform.

To identify energy improvements to current equipment that will increase capabilities to the Warfighter, the Department should:

- Identify current platforms that consume significant amounts of energy, have significant remaining service life, and are fielded in sufficient quantities;
- Evaluate whether technology advancements can improve energy usage;
- Assess what warfighting capabilities will be improved and by how much;
- Determine the cost of implementing these upgrades.

These assessments should be developed by the Services on an annual basis and shared with the Office of the Secretary of Defense (OSD) to inform resourcing decisions.

Assessment. The DOEB assessed the target as complete as each Service has an annual process that assesses opportunities to increase the energy supportability of current equipment with extensive remaining service lives. The Army uses the Strategic Management System and the Equipping Program Evaluation Group; the Navy uses formal assessments during the Program Objective Memorandum (POM) process and policy pertaining to recurring assessments of legacy programs; and the Marine Corps uses Marine Corps Order 3900.19 that applies energy performance metrics and measures in requirements development and acquisition decision making.⁵ The Air Force developed a new process to identify, prioritize, and review upgrade opportunities in the Air Force Corporate Structure decision process. Each Service will provide a prioritized list of upgrade opportunities to the ODASD(OE) by March of 2017 for discussion at the following Deputy DOEB or DOEB.

⁵ http://www.hqmc.marines.mil/Portals/160/MCO%203900_19.pdf

Assess improvements needed in energy information systems to increase supply chain visibility.

Background. While continuing to improve the understanding of its energy use, the Department still lacks end to end energy visibility. By improving the fidelity of energy information available to commanders and planners to account for energy use across all types of equipment, the Department will be able to plan and execute operations more effectively. DLA Energy led a review of current energy information systems to identify and scope requirements for enhancing the Department ability to accurately track and report on the energy supply chain.

Assessment. DLA Energy evaluated the improvements needed in energy information systems to increase supply chain visibility, and the DOEB assessed this target as complete. DLA Energy's specific findings included the lack of a DoD-wide Common Operating fuel supply chain system, limited to no visibility of tactical fuel at non-capitalized locations, and limited tactical-level interfaces between various DoD energy systems. To mitigate this gap in capability, DLA Energy is considering expanded use of the DLA Accountable Property System (APS) across the Department to enable improved Service visibility on fuel use. DLA Energy also supports the development of the Army's Wireless Sensor mesh system, an automated program that wirelessly captures fuel use at platform level and reports back through the DLA APS.

Changes in the operational environment and the increasing risks to sustaining current and future forces led the Department to update the *Operational Energy Strategy* in 2016. Throughout FY 2016, the Department made progress by reaching strategy targets associated with adapting the requirements process and concepts of operation to respond to challenges to energy supportability; improving the resilience of our supply chain through the ability to use alternative fuels, understanding the risks and opportunities of commercial fuels and infrastructure, and enhanced energy information systems; and enhancing mission effectiveness through identification of opportunities for operational energy-related upgrades to current forces. Future editions of this report will update the Congress on progress on the remaining nine targets.

Operational Energy Actions in FY 2016

While the *Operational Energy Strategy* guided specific efforts, the entire Department continued a broad range of actions to mitigate risk and improve capability. Beyond issuing a new strategy, the Department coordinated JROC changes through the knowledge management decision support system for multiple acquisition programs, participated in numerous Service and Office of Net Assessment wargames to ensure OE equities were well represented, and hastened the diffusion of technology and best practices through conducted communities of practice with Component Commands and Agencies. Specific achievements for FY 2016 are detailed below.

Office of the Secretary of Defense

Within OSD, the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment (OASD(EI&E)) and DLA Energy led operational energy activities in FY 2016. Foremost, the ASD(EI&E) issued a revised *Operational Energy Strategy* in February 2016. Using the FY 2011 *Operational Energy Strategy* as a baseline, workgroups that included DoD, agencies, the Services, and Combatant Commands (CCMDs) met and refined the updated strategy. Objectives, goals, targets, and OPR were developed that honed each target and briefed back the results at semi-annual DOEBs for approval and follow on activities.

In accordance with title 10, U.S.C., section 2926, ASD(EI&E) continued to review the adequacy of the President's Budget for carrying out the *Operational Energy Strategy*. First, the Department completed the review of the FY 2017 President's Budget and concluded the budget was adequate for implementing the strategy.⁶ The Department also initiated the review of the FY 2018 President's Budget by issuing POM guidance to the Military Departments and reviewing briefings at the Assistant Secretary and Deputy Assistant Secretary-level on Department investments in operational energy specific briefings. The Department will use these POM evaluations to evaluate the final President's Budget in the spring of 2017.

To better institutionalize operational energy thinking and principles, the Department continued to review and adapt existing policy and doctrine. OASD(EI&E) assisted with the revision of roles and responsibilities for DLA Energy, initiated a review of standardization activities for mobile electric power systems, and participated in the Global Posture Executive Council as DoD oversight body for Global Defense Posture.⁷ The Department also included language into the 2016 Global Defense Posture Guidance that requires the Geographic CCMDs to address Operational Energy (OE) gaps and risks in future Theater Posture Plan cycles. Finally, the Department adapted multiple

Policy and Doctrine Actions in FY 2016

- DoDD 5101.22, Defense Logistics Agency Charter
- DoDD 5101.08, Executive Agent for Bulk Petroleum
- DoDI 3000.12, Management of US Global Defense Posture
- DoDI 4120.11 Mobile Electric Power Systems
- DODM 41401.25, Policy for Energy Commodities and Related Services
- Joint Publications 3.0 (Joint Operations), 4.0 (Joint Logistics), and 5.0 (Joint Operation Planning), 4-01 (Defense Transportation System), 4-04 (Joint Basing), 4-05 (Joint Mobilization) and 4-08 (Logistics in support of Multinational Operations)
- Global Posture Guidance
- Joint Concept for Access and Maneuver in the Global Commons

⁶ FY 2017 Budget Certification Report is at :

http://www.acq.osd.mil/eie/Downloads/OE/2017_Budget_Certification_Report_20170701.pdf

⁷ DOD INSTRUCTION 3000.12, Management of U.S. Global Defense Posture (GDP) can be found at

<http://www.dtic.mil/whs/directives/corres/pdf/300012p.pdf>

Joint Publications to ensure that operational energy risks and opportunities are integral to the planning and execution of military operations.

The ASD(EI&E) also continued to lead DOEB. In particular, the co-chairs, ASD(EI&E) and the Vice Director for Logistics (VDJ-4), Joint Staff, used the board to support the implementation of the updated *Operational Energy Strategy*, and directed in-depth studies of propulsion options for improving the capabilities of the F-35 and the challenges and opportunities of DoD-unique fuels and additization.

OASD(EI&E) continued to shape the experimentation, analysis, and review of future capabilities. For instance, staff from ODASD(OE) participated in Service and agency wargames as subject matter experts in operational energy, modeling, and simulation. This combination assisted Services and agencies both in the planning and execution of wargames, as well as the subsequent analysis of results. ODASD(OE) played key roles in both the Air Force's 2016 Global Engagement Title X game and DLA's 2016 logistics game. ODASD(OE) also provided subject matter expertise to assist the Joint Staff J-4 in reviewing JCIDS documents and assessing the adequacy of the eKPP and the ESA.

The OASD(EI&E) continued to coordinate with the CCMDs to enable improvements in the use of energy in current operations around the globe. In the form of lessons learned, analyses, and subject matter expertise, OSD provided support to Warfighters worldwide, including:

- Agadez Base Camp Optimization. OSD collaborated with Army Program Manager Expeditionary Energy and Sustainment Systems (PM E2S2) and Army Product Directorate for Contingency Base Infrastructure to provide a master plan for this Air Force site that will satisfy Commander's intent and serve as a template for future locations.
- Expeditionary Power Generation. OSD collaborated with PM E2S2 to correct power generation and distribution issues, and improve energy use and safety at Camp Simba, Kenya, and the Theater High Altitude Air Defense radar site in Guam.
- Sustainable Microgrids for Remote Locations. ODASD(OE) staff participated in the Defense, Diplomacy, and Development Innovation Summit designed to promote collaborative, whole-of-Government, innovation to solving emerging global challenges. Selected from a pool of over 500 applicants, a joint DoD, United States Agency for International Development, and Power Africa effort proposed the use of locally available power grids to support communities in remote parts of Africa while also providing power, when available, to U.S. contingency bases.

- Host Nation Power Study. The Department initiated a study on the costs and benefits of using host nation power at overseas contingency and enduring bases, and to provide recommendations on when to connect to host nation power grids. The evaluation of four locations in Honduras, Niger, and Burkina Faso concluded that host nation power can provide a substantial reduction in logistical support.

Within OSD, DLA Energy is a critical partner to OASD(EI&E). In FY 2016, DLA Energy pursued a range of improvements to policy, energy information systems, and alternative fuels certification.

In March 2016, the DLA Energy Quality Technical Office published Change 1 to the MIL-STD-3004D (DoD Standard Practice Quality Assurance/Surveillance for Fuels, Lubricants, and Related Products) to incorporate new commercial JET A/A1 quality practices and added new test requirements for various products. The document provides guidance for quality requirements to assure product arrives to customers on specification. DLA Energy coordinated with the Air Force, Army, and Navy to produce the document.

DLA Energy also engaged the Services to improve tactics, techniques, and procedures for deployed forces. In collaboration with the Army and Marine Corps, DLA Energy is working with stakeholders to extend the DLA Energy APS for Service Owned Fuel. DLA Energy currently provides automated fuel accounting software to the Services to the point of issue and/or consumption for DLA Energy Owned Fuel at capitalized sites. The Army and Marine Corps have sought use of DLA's software, to manage Service-owned (non-capitalized) petroleum and forgo the costs of developing or procuring Service-unique software. In response, a DLA Energy-led working group concluded that the Accountable Property System for Service Owned Fuel should be extended for use by the Army and Marine Corps. While under final review by OSD at the end of FY 2016, DLA is prepared to include the APS requirement in the Program Budget Review process and respond to any Resource Management Decision aligning mission and funding.

DLA Energy also launched a Fuels Training Portal that provides access to energy and supply chain policies, desk guides, instructional videos, and formal training applications. Additionally, the portal consolidates records and facilitates management visibility of curriculum accomplishment by individuals, including American Council on Education-accredited courses. Including ten new, topic-specific instructional videos, the portal became fully operational in October 2015.

Finally, DLA Energy oversaw RDT&E activities related to alternative fuels, product specification and test development, and improved analytical tools for investigation of quality issues. For instance, DLA Energy's Energy Readiness Program assisted with the completion of phase I of the National Jet Fuels Combustion Program (NJFCP), a Federal Aviation Administration

(FAA) led interagency and commercial industry effort to develop combustion models to reduce the cost and time needed to screen and advance candidate fuels for certification and approval for use in aviation fuel specifications. DLA Energy will continue to support the program in phase II and beyond through the Energy Readiness Program.

Air Force

Energy availability and resiliency affect all Air Force missions – every military capability, mission, and member of the Air Force depends on a reliable supply of energy. In order to maintain the Air Force’s critical airpower contributions to national security, the Air Force has developed a comprehensive approach to energy management to improve its ability to manage supply and demand in a way that enhances both mission capability and readiness. By developing a robust, resilient, and ready energy posture, the Air Force will enable its Warfighters, expand operational effectiveness in air, space, and cyberspace, and provide mission assurance through energy assurance.

In FY 2016, the Air Force made significant strides in revamping policy, doctrine, and guidance. Specific accomplishments include revising the USAF Energy Policy Directive and the USAF Energy Flight Plan with publication expected in early FY 2017, drafting a new Air Force Instruction on OE with target publication date of late FY 2017, and initiating the revision of the OE Governance structure and process.

In order to support the Air Force’s *Making Every Dollar Count* initiative, the Deputy Assistant Secretary of the Air Force for Operational Energy (SAF/IEN) hosted a multi-Major Command (MAJCOM) continuous process improvement event, and championed three additional multi-MAJCOM events to refine OE efficiency metrics for presentation to the Air Force Council. Through these events, the Air Force identified shortfalls in aviation fuel consumption data collection, storage, and retrieval, and began implementing process and policy changes to improve the utility of data presented in OE efficiency metrics. Lastly, SAF/IEN advocated for policy changes to return a portion of savings generated from energy efficiency initiatives to the sponsoring organization to promote further OE initiatives and encourage positively trending behavioral change. These changes have been incorporated into the Air Force’s *Making Every Dollar Count* memorandum.

FY 2016 saw a renewed emphasis within the Air Force on OE education and training. SAF/IEN led a strategic-level gap analysis of OE education and training that started with service guidance and continued into the identification of various owners of the education and training processes. The result was a plan to codify OE education and training into policy, identify OE education and training priorities, and structure an interface with key education and training organizations. While this formal effort was underway, SAF/IEN continued its efforts in behavior

and culture change through visits to major commands and wings, high-level speaking engagements, and hosting senior-level panel discussions where Airmen were able to hear the Air Force priorities of Optimize Demand, Assure Supply, and Increase Resiliency.

The Air Force also assessed the role of operational energy in expeditionary operations through three wargames in FY 2016, including Global Engagement 16, the Global Mobility/Agile Combat Support Wargame, and the Long Duration Logistics Wargame. The Global Engagement exercise doubled the size of the logistics cell, including allies and other services, in an effort to identify resiliency and survivability vulnerabilities in the fuel supply chain during the first two weeks of a conflict. The Global Mobility/Agile Combat Support Wargame looked at the energy order of battle and the Air Force's ability to support the air refueling requirements of our sister services and allies. The exercise reviewed time-phased force deployment data, command structure, disposition of personnel, and equipment. The Long Duration Logistics Wargame focused on sustaining a conflict for 180 days. Great attention was given to fuel supply chain execution, war readiness material, aircraft sortie generation, and adaptive basing as a response to A2/AD denial efforts by enemy forces.

These exercises highlighted several issues for follow-on action, including the need for an ability to introduce additives at forward locations. The Air Force addressed this need with the continued deployment of Fuels Operational Readiness Capability Equipment (FORCE) and the on-going development of palletized additization equipment. The exercises also highlighted the need for multi-modal fuel delivery and distribution options as critical factors in assuring supply in an A2/AD scenario. To address this issue, the Air Force worked jointly with DLA Energy on its efforts to grow the amount of available fuel to Warfighters worldwide. Lastly, the Air Force addressed fuel war readiness material (WRM) in the POM and with Combatant Commanders, gaining assistance in the procurement of WRM equipment from DLA and United States Transportation Command.

The Air Force also continued to develop the Joint Operational Energy Modeling and Simulation (JOEMS) project, a modeling and simulation (M&S) environment developed by Lockheed Martin under the leadership of SAF/IEN with advisory assistance from OSD and each of the Services. Once developed, JOEMS will provide OE campaign-level analysis capability for decision makers to compare weapon system/technology capabilities, support OPLAN development, develop OE support plans, and evaluate adaptive basing concepts. Two proof-of-concept phases were completed in FY 2016. Phase one used a Defense Planning Scenario to identify OE-related metrics that JOEMS can identify and measure with respect to a weapon system's effect on related logistics forces and infrastructure. Specifically, Phase one used current F-35A aircraft configuration for the baseline case and used F-35A aircraft with a more fuel-efficient engine for an excursion case. Phase two built on Phase one by utilizing a KC-46 energy supportability scenario.

With approximately 85 percent of the Air Force's annual energy costs attributed to aviation fuel procurement, a major focus of Air Force's Science and Technology programs is research and development in aviation energy efficiency. A primary area of emphasis is adaptive jet engine technology which enables next-generation combat aircraft capability by combining the fuel efficiency of high-bypass turbofan engines used by commercial airlines with the performance characteristics of military fighter engines. The Adaptive Engine Technology Development (AETD) program carried on proof of concept work accomplished by the 2014 Adaptive Versatile Engine Technology program (ADVENT) program, and achieved significant FY 2016 accomplishments including various adaptive engine component risk reduction rig tests, the manufacturing of core engine components, and initial assembly of core modules for future testing.

The work accomplished under AETD transitioned to the Air Force Life Cycle Management Center (AFLCMC) through the Adaptive Engine Transition Program (AETP). After the contract was awarded in June, both contractors completed a full requirements review and have initiated detailed design activities. AETP will focus on maturing fuel-efficient adaptive-cycle engine technologies, demonstrating flight-weight adaptive engines, and reducing associated risk in preparation for revolutionary, next-generation propulsion system development for multiple combat aircraft applications. AETP capitalizes on progress toward fuel economy and performance goals: an increase of 25 percent fuel efficiency, significant improvements in thrust and range, as well as marked improvement in thermal energy management throughout the entire propulsion system. This effort represents continued strong investment by the Air Force to be the preeminent leader in fighter engine technology with a strong emphasis on increased range, endurance, performance, and thermal management.

In addition to AETD and AETP, several other Air Force science and technology efforts were accomplished in FY 2016 with OE efficiency as a primary driver. For instance, AFRL continued developing and assessing aerodynamic technologies which will ultimately realize additional increases in fuel efficiency beyond those achieved by propulsion system advances. One such technology is the C-17 formation flight control software and mission planning tool for the Surfing Aircraft Vortices for Energy (\$AVE) effort. Software development was completed in FY 2016 and its application in \$AVE is projected to decrease drag for the trailing vehicle by 10 percent. Additionally, the AF completed feasibility flight tests of C-17 aft body drag reduction finlet devices showing approximately one percent drag reduction. Lastly, the Air Force Advanced Power Technology Office (with help from AFRL/RQ, AMC, AFSOC and USSOCOM) completed 3 OE demonstrations. The demonstration of Large and Small Thermoplastic Components for Weight Reduction showed the potential to decrease C-17 part weights by 25 percent to 40 percent; initial testing on C-130 Winglets and Lift Distribution Control System demonstrated an increase in fuel savings by two percent averaged across all MC-130J mission sets; and the demonstration on C-130 Ullage Reduction showed a potential increase of on-aircraft C-130 fuel storage by 3800 lbs.

Finally, the Air Force made significant progress in incorporating OE into requirements and acquisition processes. SAF/IEN worked with the AF requirements teams to provide clearer and more accessible OE guidance to the major command sponsors, including the use of an eKPP checklist and the development of an ESA template. The eKPP checklist and ESA template demonstrate significant strides toward aiding requirements and acquisition personnel in meeting the expectations of the Joint Staff and OSD. Lastly, SAF/IEN worked with requirement sponsors and program offices throughout FY 2016 as a participant in UH-1N replacement and next generation tanker High Performance Teams, creating the opportunity to leverage OE expertise across the requirements of multiple programs.

The Air Force used 2016 to redefine operational energy by reassessing/affirming its position in corporate structure, introducing it into new areas such as education and training as well as early acquisition, and by bringing an operational energy focus to wargames and M&S efforts. Additionally, the Air Force continued its efforts to incorporate operational energy into its science and technology programs ensuring the enhancement of its three operational energy priorities of optimize demand, increase resiliency, and assure supply.

Army

At the tactical level, energy can constrain an Army unit's endurance and limit flexibility and freedom of action. Both mounted and dismounted forces rely on a routine, predictable resupply of fuel and batteries, which trades sustainment for momentum, exposes Soldiers to tactical risks, and limits commanders' options. To this end, the 2015 *Energy Security and Sustainability (ES2) Strategy*, warns that the Army "can no longer assume unimpeded access to the energy, water, land, and other resources required to train, sustain, and deploy a globally responsive Army." This ES2 Strategy was based upon the principle of resiliency, enhancing the Army's adaptability to rapidly deploy, fight, and win whenever and wherever our national interests are threatened. In FY 2016, ASA(IE&E) strived towards the goals identified in the ES2 Strategy through a holistic attempt to generate combat effectiveness through the informed use of resources and application of standards.

Much of FY 2016 was spent implementing the Army's *Energy Security & Sustainability (E2S) Strategy* to use resources wisely, minimize demand by increasing both efficiency and recovery to maximize resources, provide reliable access, build resiliency, and drive innovation. As part of a working group on energy resiliency, The Combined Arms Support Command (CASCOM) incorporated OE concepts into 14 publications and reviewed 67 publications. CASCOM also spent FY 2016 developing three new Army Techniques Publications related to Tactical Electric Power, Engineer Prime Power, and Tactical Power Equipment Operator Training.

The Army approved a Contingency Basing Policy in December 2015 to delineate desired

outcomes and assign responsibilities for achieving effectiveness, efficiency, and resiliency at Army contingency bases. In addition, the Army is developing a regulation to standardize the design, construction, sustainment, management, and closure of contingency bases. The Army Regulation (AR) for contingency basing is scheduled for publication at the end of FY 2017. As the Army reduces its footprint, the Army's goal is to sustainably manage contingency basing functions without compromising expeditionary standards.

To improve technical skills and understanding of OE best practices, CASCOM began implementing the Training and Doctrine Command OE Training Strategy. This strategy outlines a means to integrate general OE awareness, planning techniques, and technical skill training into the Army's institutional, operational, and self-development training domains. The intent of the strategy is to include OE techniques and ideas in current curriculums and make the information available via distance learning platforms rather than competing for limited resources to create stand-a-lone courses. In support of the strategy, CASCOM continued to refine and develop operational energy-related training support packages and supporting materials for potential incorporation into Soldier and leadership courses. This effort will continue in FY 2017 with the goal of piloting four training and education modules on general OE awareness and power production and distribution planning.

Energy also plays a role in Army exercises, and includes the Network Integration Evaluations (NIE) and Army Warfighting Assessments. These venues are capstone events that drive innovation and integrate industry partners to focus on Joint and Multinational Interoperability, training readiness, and future force development. In FY 2016, the NIE 16.1 provided a venue for early prototype experimentation in a realistic operational environment allowing industry partners to improve engineering and system development while working side-by-side with Soldiers to rapidly improve capabilities. NIE 16.1 demonstrated and assessed base camp life support and energy efficient capabilities as part of Force 2025 Maneuvers. Follow-on assessments to NIE 16.1 are planned in FY 2017 and FY 2018.

To support Army-wide modeling and analysis, the Army established the Operational Energy Analysis Task Force (OEATF) in FY 2012. In FY 2016, the OEATF expanded the capability to conduct detailed theater-level modeling, simulation, and analysis of contingency bases of various different sizes supporting Stability Operations. This is a new Army analytical capability, and will benefit the design of new equipment and planning for use in operations. During FY 2016, Product Director Contingency Base Infrastructure used OEATF to improve the optimization capabilities of the Whole System Trade Analysis Tool, refine the resource (fuel, water, power, waste reduction) usage calculations in the CBI Mini-Model, and the resource consumption over time (adding equipment availability calculations) capabilities of the System of Systems Analysis Toolset to better reflect potential real-world cost savings.”

To shape research and development efforts, the Army established a goal for the dismounted Soldier to have 72-hour endurance without resupply of batteries at a weight of 6.3 pounds. Already, the Army has reduced the 72-hour battery load from 13.3 pounds to 8.9 pounds, simplifying Soldier power supply and providing options for recharging batteries while on the move. FY 2016 initiatives focused on simplifying and reducing Soldier power demands through miniaturization and standardization, combining capabilities into single devices, or better-informed choices by small unit leaders on capabilities needed to conduct a mission.

Beyond the dismounted Soldier, the Army's continued to fund the Improved Turbine Engine Program (ITEP) for Blackhawk and Apache helicopter engines. Originally developed with 1960s technology and fielded in the 1970s, the T700 engine in both helicopters is reaching its effective limits and can no longer provide needed high altitude/hot weather performance. ITEP has the potential to deliver a 13 to 25 percent reduction in fuel use relative to the current Blackhawk and Apache engines, better performance in hotter temperatures and increased altitudes, and reduce maintenance costs by 35 percent. In FY 2016, the Army awarded two contracts for development of the Improved Turbine Engine Preliminary Design.

For combat vehicles, Army efforts have concentrated on upgrading power generation and distribution and reducing fuel consumption to support new capabilities. As protective and mission command capabilities have been added to armored vehicles, the result is often decreased mobility, less reliability, an insufficient power reserves to use these new capabilities. The Army program to install an Auxiliary Power Unit (APU) on the M1 Abrams tank will be able to power the tank at the halt without running the main engine, making the vehicle approximately nine percent more fuel efficient overall. The production contract for the M1 APU was awarded in FY 2016, with production beginning in FY 2017, and fielding in FY 2020.

In FY 2016, the Army also fielded a suite of Small Unit Power equipment that included an Integrated Soldier Power/Data System with conformal battery; Squad Power Manager for scavenging battlefield power; and a Universal Battery Charger. These systems fill current power and energy needs created by the increase in mission essential electronics used by Soldiers such as Nett Warrior, displays, GPS systems, weapon sensors, radios, and other devices thereby enhancing mission command warfighting functions and situational awareness.

Advanced Medium Mobile Power Source (AMMPS) generators also continued to replace old, inefficient generators, reducing our fuel consumption. The AMMPS improves fleet-wide generator efficiency by 21 percent while operating on military standard kerosene-based fuels (JP8), which reduces the amount of fuel transported through contested environments and limits the risks to personnel and equipment moving fuel. A total of 2,063 AMMPS systems were fielded in FY 2016.

Department of the Navy

During 2016, the Department of the Navy demonstrated energy technologies and improved operational procedures to increase the operational capability of Naval Forces. The Great Green Fleet deployment established specific energy goals for the Navy and Marine Corps, operationalizing technologies and energy control measures in formations such as Marine Expeditionary Units and Carrier Strike Groups in order to extend time on station and the operational reach of our weapons systems while reducing energy related vulnerabilities of deployed forces. This as well as the ability to capitalize on diversified fuel supplies, and international naval interoperability was also demonstrated through the use of synthetic fuels. Based on a DLA Energy solicitation and award, 77 million gallons of an alternative marine diesel blend was used by the U.S.S. STENNIS Carrier Strike Group and other U.S. and partner ships operating in the Pacific region. The 2016 demonstration results will be used to establish a new normal for energy based on operational capability.

Marine Corps

In the Marine Corps Operating Concept, released in September 2016, the Commandant of the Marine Corps stated “Energy is a critical enabler of warfighting capabilities and directly affects the operational reach of the MAGTF.” This guiding document defines four lines of effort to improve the Marine Corps operational energy capability: understanding energy risk, system-of-systems capability development, enhanced operating concepts, and training. This top level guidance ensures that energy is considered across the entire Marine Corps.

To better understand operational energy risks to warfighting, the Marine Corps is improving the role of energy in wargames, concepts, and plans through an assessment of operational energy-related risks in Operations Plan 5015. The study should be complete in the 2d Quarter, FY 2017. The Expeditionary Energy Office used the results of the Operational Reach 2015 wargame based on a modified Defense Planning Scenario to inform ESA for the LHA-8 amphibious assault ship, LX(R) dock landing ship, ship-to-shore connector, LCU-1700 landing craft, CH-53K heavy-lift utility helicopter, Joint light tactical vehicle (JLTV), amphibious combat vehicle 1.1, and the F-35B version Joint Strike Fighter. In addition, an Expeditionary Energy and Water Concept Paper is under development that will include a set of functional water and power foraging capabilities that increase mobility and reduce sustainment during amphibious operations in the future operating environment. Throughout the Fiscal Year the Marine Corps identified opportunities to leverage M&S to assess operational energy-related risk in OPLANs and Defense Planning Scenarios.

In the area of capability development, the Marine Corps is supporting a range of research and development, as well as acquisition initiatives. In FY 2016, research, development, test, and

evaluation (RDT&E) projects included the Joint Infantry Company Prototype that harvests or scavenges energy from dismounted Marines, Hybrid Tiger multi-day endurance Unmanned Aerial Vehicle, Rolling Fluid Transporter (fuel stored, transported and dispensed from tires pulled behind carriers), and the Dracone (towed bladder carrying liquid cargo) for ship to shore fuel movement during amphibious operations. In addition, the Marine Corps is teaming with the Army on the Joint Operational Energy Command and Control project to increase operational reach of the Marine Air Ground Task Force (MAGTF) by increasing a Commander's understanding of unit energy performance. Previous and current demonstration efforts focused on battalion fire and maneuver elements, while future demonstrations, if funded, will support a MAGTF during FY 2017 and FY 2018.

The Marine Corps also continued to field new OE-related equipment to increase the operational reach and lethality of the MAGTF. Continuing the successes established in the Experimental Forward Operating Base, the Marine Corps evaluated over a dozen technologies in Expeditionary Energy Concepts 2016 that focused on water purification, mobile electric microgrids, energy scavenging, and forward medical capabilities. Improvements that were identified included some components of the Fuel-Efficient Medium Tactical Vehicle Replacement (MTVR) program and Lithium Ion battery now being evaluated for the Network On The Move system. Furthermore, the Ground Renewable Expeditionary Energy Network System (GREENS) version II, which uses arrays of solar panels and rechargeable batteries to provide an average continuous output of 300W, was fielded to operating forces in FY 2016. The Soldier Portable Alternative Communications Energy System (SPACES) version II – a foldable solar blanket – also was fielded to the operating forces in FY 2016, and provided significant solar power generation efficiency improvements.

To codify the role of energy in operating concepts, the Marine Corps also began development of a Marine Corps Order that will delineate responsibilities, direct the implementation of energy considerations in force development, training, and education, and institute a mandate for energy accountability for units, commanders, and Marines. In addition, operational energy considerations were included in the revision and consolidation of three foundational doctrinal logistics publications into *Marine Corps warfighting Publication (MCWP) 3-40 Logistics Operations*.

Finally, the Marine Corps continued to update doctrine, training, and education for Marines. The Marine Corps collected data and best practices on energy behavior and planning during unit exercises at the Marine Corps Air-Ground Combat Center to inform future tactics, techniques, and procedures, and Training and Readiness (T&R) standards. Similarly, the Behavioral Energy Modeling and Demonstration (BEyOnD) assessment targeted improvements in vehicle operations and efficient employment of diesel generators and Environmental Control Units (ECUs). BEyOnD demonstrated that savings between 9-20 percent are possible at remote bases

and savings up to 10 percent may be achievable through vehicle behavior interventions. Finally, Training and Education Command identified opportunities for incorporating energy planning and accountability/behavior training in formal school and professional military education curriculums (e.g., Basic Motor Vehicle Operators Course), and energy courses were introduced at the Naval Postgraduate School (NPS).

Navy

The Navy considers energy a strategic resource essential to the successful execution of Navy's afloat and ashore missions. With the goal of increasing operational capability and resilience by decreasing the reliance on petroleum and increasing the use of alternative energy in operations and facilities, the Navy Energy Strategy encompasses robust investments across the Aviation, Expeditionary, Maritime, and Shore enterprises. To increase combat readiness and mission success, the Navy will make significant short-term gains by adjusting policies to enable more energy efficient operations, encouraging awareness and energy-conscious behavior, optimizing existing technologies to reduce energy consumption, and accelerating the implementation of new technologies.

The Navy is cultivating a new generation of 'energy warriors' through incentives and education. The incentivized Energy Conservation program encourages ships to apply energy efficient procedures and operations during all suitable ship missions, whether underway or in port and promulgates best practices across the Fleets. In FY 2016 the Aircraft Energy Conservation Program implemented standard operating guidance documents and other tools for use by the Fleet to optimize fuel consumption on the Navy's 3,700 aircraft. Beyond these shipboard and aircraft applications, the NPS hosts the "Leading Innovation with an Energy Application Focus" seminars for Flag-level executives. Additionally, NPS offers four master's degree programs and graduate certificates with an energy focus for Navy and Marine Corps personnel; Master of Science in Operational Analysis, Naval/Mechanical Engineering, Electronic Systems Engineering, and Financial Management. Finally, the Energy General Military Training achieved its Navy-wide rollout in FY 2016.

Navy's maritime efficiency initiatives seek to reduce energy demands on ships, both for propulsion and electric power. Passive technologies such as Stern Flaps reduce drag and reduce energy use while the ship is operating across its entire speed range. Active technologies, such as the Hybrid Electric Drive (HED), are used when tactically appropriate, and deliver savings only while in use. HED is on schedule for installation on three DDG 51 class ships in 2017 and will contribute to greater presence and reach by extending range and time between refueling. The Shipboard Energy Dashboard provides real-time situational awareness of the energy demand associated with equipment onboard a ship in order to enable optimized performance. The potential savings in reduced fuel burn for the shipboard electric plant translates into crucial additional hours

between refueling thus increasing the operational capability of the ship. In addition to being installed on 18 DDGs already, energy dashboards will be installed on an additional six DDGs in FY 2016 and two in FY 2017. In FY 2016, Navy continued to install solid state lighting across the surface fleet, with expected savings of over 400 barrels of fuel per ship per year, and reduced maintenance hours compared to traditional florescent lighting.

For naval aviation, Navy research is focused on new turbine engine configurations using innovative materials and processes to decrease fuel consumption and cost, while increasing aircraft operational availability and performance. This includes developing new high temperature metal alloys and inter-metallic materials for lighter and more heat resistant turbine blades and disks, and thermal/environmental barrier coatings systems to improve component heat resistance to obtain greater fuel efficiency. The Navy's Fuel Burn Reduction (FBR) initiative for the F-35 completed a successful rig test in FY 2016 to validate performance, and is on track to complete all stationary tests by early in calendar year 2017. If implemented, the FBR is projected to result in an average 5.9 percent reduction in fuel consumption across all three F-35 variants, contributing to increased range and reduced in-flight tanking frequency. The Navy also continued to invest in trim-optimizing flight controls for F/A-18 and F-35, which will further enhance the range and flight time of these aircraft by ensuring operation at the most fuel-efficient trim for a given flight condition.

Combatant Commands.

The geographic CCMDs continue to make progress on integrating operational energy into plans, exercises, and ongoing operations. Highlights include.

- Operational Energy (OE) Strategy/United States Central Command (USCENTCOM). In support of the command energy program, USCENTCOM approved and distributed a revised OE strategy to the Military Component staff, OE managers and key stakeholders. The strategy sets the overall direction of Command's operational energy goals and strategy targets. The approved strategy will be published in the Theater Campaign Plan as Appendix 9, under Annex D (Logistics).
- OE Charter/USCENTCOM. With the implementation of the new OE strategy, the USCENTCOM OE charter was revised to focus exclusively on the quarterly Joint Operational Energy Working Group (JOEWG). The Charter formalizes the Purpose, Mission, Chair, Membership, Products, Lines of Effort, and Roles and Responsibilities of the JOEWG. The JOEWG meets quarterly to facilitated discussions and information sharing between the Military Service Components within USCENTCOM regarding OE initiatives.

- OE Joint Mission Essential Tasks (JMETS)/USCENTCOM. The Command has approved and published OE specific JMETS which are being reported in the Defense Readiness Reporting System. The JMETS are based largely on the USCENTCOM OE Strategy Targets for FY 2016.
- Operational Energy Advisor/United States European Command (USEUCOM). With the assistance of the Command, the Department established an Operational Energy advisor for USEUCOM. This advisor will bring will bring a wealth of operational energy experience to the USEUCOM staff to assist with the establishment of an OE strategy, goals, and supporting guidance. This position will also provide support to USEUCOM's basing posture, energy security, and deliberate planning processes.
- Strategy and Planning/USEUCOM. As USEUCOM transitions its headquarters back to warfighting, logistics concerns – including safeguarding of the energy security posture – are growing in significance. This entails protection of critical energy infrastructure to secure operations in a contested environment. In support of this effort, the USEUCOM Operational Energy Advisor is developing language for inclusion in the USEUCOM mobility strategy and operational energy tenets in the Theater Campaign order will enable Service components to develop subordinate orders.
- Energy Strategy/United States Pacific Command (USPACOM). The updated command energy aligned to the Department strategy, and strategy enhanced warfighting capability, increased mission effectiveness and reduced energy systems risks. USPACOM initiatives to support these goals include incorporating energy security concepts into engagement activities; injecting energy problem sets into command exercises; and initiating an assessment of energy infrastructure interdependencies.
- Energy Resiliency/USPACOM. USPACOM co-hosted the Asia Pacific Resiliency Innovation Summit and Expo during the Rim of the Pacific exercise in July 2016. Topics included power generation, grid solutions, energy storage, biofuels, and emerging technologies in transportation and mobility.
- Operational Energy in Planning/USPACOM. The Joint Deployment Energy Planning and Logistics Optimization Initiative (J-DEPLOI) entered Phase II of the program and will support logistics planners with specific tools designed to develop and refine courses of action early in the planning process.

Conclusion

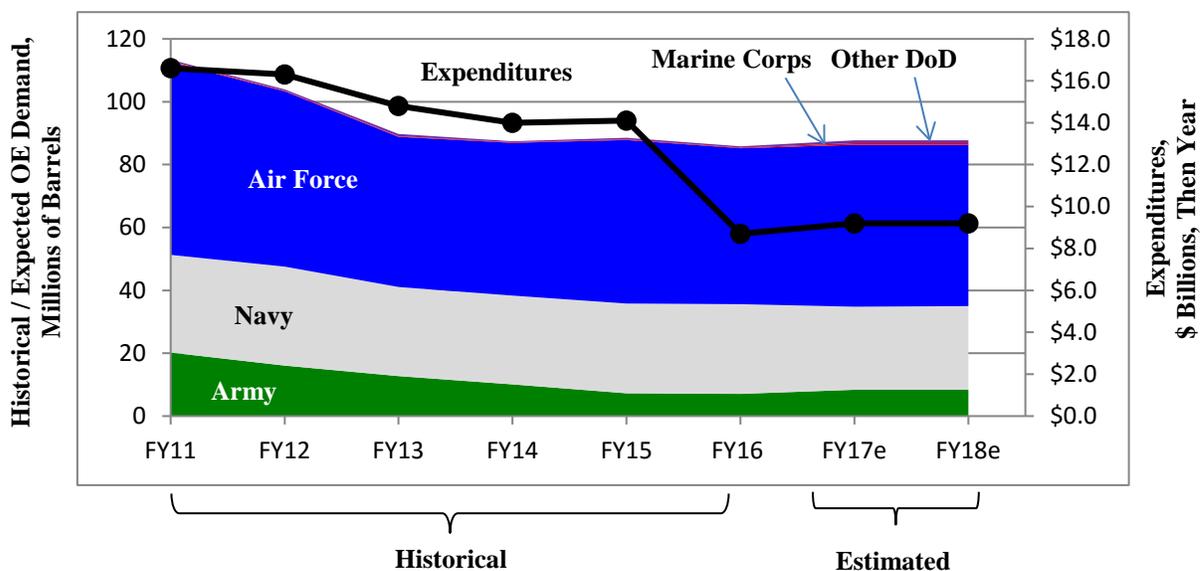
Throughout FY 2016, the Department made broad progress toward improving its use of energy in order to increase capability and reduce risk. Through a new *Operational Energy Strategy*, the Department improved capability by adapting the requirements process, improved the resilience of our supply chain, helped understand the risks and opportunities of commercial fuels and infrastructure, identified improvements in our energy information systems, and enhanced near-term capabilities through identification of opportunities for operational energy-related upgrades to current forces.

Beyond the strategy, OSD, the Services, and the CCMDs led operational energy initiatives related to policy, plans, doctrine, operations, training, education, and future force development. These adaptations reflect the continued effort by the Department to increase the “missions per gallon” available to forces training and operating around the globe. The Department continues to appreciate the support of Congress in achieving the operational energy mission for Warfighters across air, land, and sea.

Appendix A: Historical and Estimated Demand for Operational Energy

The figure and table below describe the historical demand for operational energy in FY 2011–2016, estimated demand for operational energy in FY 2017-2018, and total expenditures to purchase that fuel. Historical operational energy demand is based on net sales of selected liquid fuels by DLA-E to the Services, while future operational energy demand estimates are based on the FY 2017 President’s Budget. Expenditures for operational energy are estimated using the average fuel sales price for the specific fuel provided to the customer at the point of sale, and include procurement and overhead costs. This price does not reflect additional costs imposed on the Department for force protection, storage, and transportation beyond the point of sale. As a purchaser of fuel on the open market, the Department is subject to the same price volatility experienced by commercial customers. Throughout the Fiscal Year, Comptroller monitors the price of fuel to ensure the Services are charged fairly for their fuel use. In FY 2016, Comptroller twice adjusted down the cost of fuel to the Services from \$123.90 to \$78.96 per barrel of fuel by April 1. For this reason, while the amount of fuel consumed in FY 2015 and FY 2016 was roughly similar, the cost of fuel was more than five billion dollars less for the Department.⁸

Figure 1: DoD Operational Energy Demand, FY 2010 – FY 2017⁹



⁸ Standard DLA Energy fuel prices can be found at <http://www.dla.mil/Energy/Business/StandardPrices.aspx>

⁹ Updated analysis of expenditures may lead to different results from previous Operational Energy Annual Reports. Expenditures are not adjusted for inflation; data on historical demand may not capture final end use nor account for fuel transfers between the Services; Historical and Estimated Demand include Base and Overseas Contingency Operations (OCO) funding and purchases using Transportation Working Capital Fund (TWCF).

Table 2: DoD Operational Energy Demand by Service

		FY11	FY12	FY13	FY14	FY15	FY16	FY17e	FY18e
Operational Energy Demand, Million Barrels	Army	20.2	16.1	12.7	10.1	7.3	7.1	8.4	8.4
	Navy	31.1	31.5	28.4	28.2	28.5	28.5	26.4	26.6
	Air Force	61.3	55.7	47.8	48.6	52.0	49.6	51.5	51.3
	Marine Corps	0.3	0.2	0.2	0.2	0.2	0.2	0.5	0.5
	Other DoD	0.5	0.4	0.7	0.3	0.5	0.4	0.9	0.9
	<u>Total Demand</u>	113.5	103.9	89.8	87.4	88.6	85.7	87.7	87.7
	<u>Expenditures, \$ Billions</u>	\$16.6	\$16.3	\$14.8	\$14.0	\$14.1	\$8.7	\$9.2	\$9.2

Appendix B: Alternative Fuels Initiatives

This section is in response to the following requirement for the Operational Energy Annual Report as outlined in title 10, U.S.C., section 2925(b): *A description of the alternative fuel initiatives of the Department of Defense, including funding and expenditures by account and activity for the preceding fiscal year, including funding made available in regular defense Appropriation Acts and any supplemental Appropriation Acts.*

The Department understands that drop-in alternative fuels—that is, fuels produced from feedstocks other than petroleum which are fully functional in military engines—may offer increased capabilities and provide additional options for supplying Warfighter energy needs. Consistent with prior years, DoD’s FY 2016 alternative fuels RDT&E investments—presented in Tables 3 and 4—predominantly supported the qualification and certification of fuels produced through new alternative fuel pathways. The Military Services’ certification and qualification programs are coordinated through the Tri-Service Petroleum, Oil, and Lubricant Users Group. Through statute and policy, alternative fuels procured for use in operations will be purchased when drop-in compatible with existing equipment and infrastructure and cost-competitive with traditional fuels. Since FY 2016, DLA Energy’s bulk fuel solicitations were open to accepting fuel produced through two pathways (FT-SPK and HEFA) for JP-8, Jet A, Jet A-1, and JP-5 at up to a 50-percent blend, and also through an additional pathway (SIP) for JP-5 at up to a 10 percent blend, consistent with the updated fuel specifications presented in Table 5.

By 2012, the Air Force’s Alternative Fuels Certification Office (AFCO) completed testing and certification of the Service’s relevant aircraft for use of a 50/50 blend of JP-8 and one of two alternative fuel types, as indicated in Table 5. Additionally, in 2011, the AFCO began the process to test and certify blends of alternative fuel produced through the alcohol-to-jet (ATJ) pathway; however, limited industry supply and decreasing petroleum prices reduced the immediate practicality of furthering certification efforts with this fuel type, so the Air Force terminated the AFCO and certification efforts. When industry is able to produce alternative jet fuels in sufficient quantities at competitive prices, the Air Force will ensure it is poised for procurement of these fuels.

Although the Air Force is no longer funding certification efforts, the Air Force Research Lab (AFRL) continued to work on decreasing the cost and time required to certify new alternative fuels for use in weapons systems, largely through supporting Phase I of the NJFCP, which was completed in FY 2016 with support from the Navy and DLA Energy’s Energy Readiness Program (ERP), as described in the main report. The Air Force continues to collaborate with sister Services in assessing the need for further DoD alternative

fuels testing beyond commercial aviation efforts through the FAA, American Society for Testing and Material, and the Commercial Aviation Alternative Fuels Initiative.

The Army is pursuing innovative solutions for its tactical aviation and ground fleets that currently use kerosene-based aviation turbine fuel. For aviation and ground platforms, the Army approved the use of alternative jet fuel blends included in the JP-8 fuel specification, as presented in Table 4. Army aviation has also approved of ATJ fuel blends, but is not currently funding the testing of additional pathways.

For the Navy, testing and certification of alternative fuels remains a priority. The Navy has completed testing and qualification of aviation and naval fuels, as presented in Table 5 which enables widespread use of alternative fuels by both aircraft and ships. Alternative fuel blends will be purchased in operational quantities once they become cost-competitive with conventional fuels. In FY 2016, the Navy continued testing and qualification of alternative fuels produced through three additional pathways, and performed a demonstration flight using an EA-18G running on 100 percent bio-based JP-5 produced through the catalytic hydrothermal conversion-to-jet pathway.

Following up on the world's largest practical demonstration of non-petroleum fuel use during a "Rim of the Pacific" (RIMPAC) exercise in 2012, the Navy accomplished another major milestone through the Great Green Fleet initiative as part of the 2016 RIMPAC exercise. During the exercise, U.S. Navy ships and those of eight participating nations utilized F-76 fuels containing blends of up to 10 percent HEFA biofuel or utilized nuclear power.

**Table 3. Initiatives to Model and Develop Alternative / Non-Petroleum Fuel Feedstocks and Fuel Production Capabilities
(Dollars in Thousands)**

Service	Program Title	Initiative Title	Description	Treasury Code (TC)	Budget Activity (BA)	Budget Line Item	Program Element (PE)	FY 2016
Navy		Naval Biosciences: Biosynthesis of Liquid Fuels	Develop transformational approaches using living organisms to produce fuel components (e.g., alkanes)	1319	01		0601153N	174
Navy		Biocentric Technology-Biosynthesis of Liquid Fuels	Develop transformational approaches using living organisms to produce fuel components (e.g., alkanes)	1319	02		0602236N	192
Navy	NECO	Carbon Capture from Seawater	Finalizing the construction of the scaled-up carbon capture prototype that will produce enough carbon dioxide and hydrogen to make up to 1 gallon of fuel per day.	97X4930	020060658			250
Navy	Navy Energy	Navy Synthetic Fuel Production from Seawater	Assessment of the effects of reactor and catalyst scale-up on catalyst performance in commercial-scale chemical reactor	97X4930	020060658			250
Subtotal								866

Table 4. Initiatives to Test and Evaluate Alternative / Non-Petroleum Fuels for Use in Military Fuel Systems¹⁰
(Dollars in Thousands)

Service	Program Title	Initiative Title	Description	Treasury Code (TC)	Budget Activity (BA)	Budget Line Item	Program Element (PE)	FY 2016
Air Force ¹¹	Sweden Alcohol-To-Jet Fuel Processing and Performance		Develop the Alcohol-To-Jet (ATJ) aviation fuel process, produce a sufficient quantity of ATJ fuel to satisfy program requirements, and establish ATJ test and analysis requirements to enable a flight demonstration of a Gripen aircraft using a 50/50 blend of ATJ and JP-8.					450 ¹²
Army	Aviation Technology	Fuel Qualification and Certification Efforts	Assess the impact of using emerging alternative fuels in aviation platforms and identify changes in fuel specifications to implement alternative fuels into Army aviation systems.	2040	02	EM8	0602211A	0
Army	Combat Vehicle and Automotive Advanced Technology	Fuel Qualification and Certification Efforts	Assess the impact of using emerging alternative fuels in tactical/combat vehicles and other deployable assets, and identify changes needed in fuel specifications to implement alternative fuels into Army systems.	2040	02	H77	0602601A	1,100
Navy	Mobility Fuels	Alternative Fuels Test and Qualification	Develop technical data through the execution of laboratory, component, engine, fuel system, and weapon system tests, which evaluates the effects of changes in fuel chemistry and properties on the performance and reliability of Naval ship, aircraft, and fuel distribution systems.	1319	04	0838	0603724N	12,173
DLA Energy	Quality/Technical Support Office – Energy Readiness Program	Effect of Alternative Jet Fuels on Combustor Operability Limits	Evaluate specific alternative fuel samples in an auxiliary power unit (APU) combustor rig to develop an understanding of alternative fuel composition effects on combustor operability, particularly pertaining to criteria of engine lean blow out and altitude relief. Air Force Research laboratory is performing this work as part of a larger joint Air Force/FAA initiative, the National Jet Fuel Combustion Program	0400	03		0603712S	98
Subtotal								13,821
Total Budgeted / Obligated in FY 2016								14,687

¹⁰ These initiatives include the procurement of alternative fuels to support testing and evaluation activities.

¹¹ The rightmost cell in this row presents an estimate of the Air Force’s non-financial contributions (e.g., salaries, background information, use of equipment). The Navy’s contribution to this project is supported through PE 0603724N, which is fully described in a separate row.

¹² This is an estimate of non-financial contributions (e.g., salaries, background information, use of equipment).

Table 5. Approval Status for the Blending of Alternative / Non-Petroleum Fuels into Commercial Jet (Jet A and Jet A1), Military Jet (JP-8 and JP-5), and Naval Distillate (F-76) Fuels

Specification owner:		ASTM	USAF	DON	DON
Specification number:		D7566/D1655	MIL-DTL-83133J	MIL-DTL-5624W	MIL-DTL-16884N
Fuel Pathway	Maximum Blend	Jet A and Jet A1	JP-8 (Jet)	JP-5 (Jet)	F-76 (Distillate)
FT-SPK	50%	Sep 2009	Apr 2008	Jul 2013	Apr 2014
HEFA-SPK	50%	Jul 2011	Oct 2011	Jul 2013	Apr 2014
SIP	10%	Jun 2014		Mar 2016	
FT-SKA	50%	Nov 2015			
ATJ-SPK	30%	Apr 2016			

ATJ = Alcohol to Jet (derived from butanol)

FT = Fischer-Tropsch

HEFA (aka HRJ or HRD) = Hydroprocessed Esters and Fatty Acids (aka Hydroprocessed Renewable Jet or Diesel)

SIP (aka DSH) = Synthetic Isoparaffin (aka Direct Sugar to Hydrocarbon)

SKA = Synthetic Kerosene with Aromatics

SPK = Synthetic Paraffinic Kerosene

Appendix C: Operational Energy Capability Improvement Fund (OECIF)

The mission of OECIF is to improve the Department’s operational effectiveness through targeted investments in operational energy science and technology (S&T). OECIF funds serve as “seed money” to consolidate or start promising operational energy programs, directions, or changes to be sustained by the Services.

As Department-wide funding, OECIF uses S&T to promote long-term change in the Department’s capabilities and alignment with the Department’s Operational Energy Strategy. Established in FY 2012, OECIF programs are selected from Service nominated proposals that are prepared in response to an annual ODASD(OE) theme. The programs receive approximately four years of incremental funding and are managed and executed by their respective Services.

Since FY 2012, OECIF has funded a series of programs, as shown in Table 6. By the end of FY 2016, the programs started in FY 2012 have largely concluded and most have either fully transitioned to follow-on work or are working towards identifying follow-on funding. A program focused on increasing soft wall shelter insulation efficiency developed incremental shelter improvements along with testing to evaluate those improvements. A series of tests conducted in hot and cold environments indicated efficiency increases of up to 50 percent, and the Army and Air Force have contributed over \$20 million from

Table 6. OECIF Programs, FY 2012-FY 2017

Start Year	Theme
FY 2012	<u>Reducing energy load at expeditionary outposts</u> , with an emphasis on energy efficient shelters and cooling
FY 2013	Using <u>consortia</u> to involve a wide variety of organizations to persistently attack key operational energy problems
FY 2014	<u>Analytical methods and tools</u> for considering operational energy in Department planning and decision processes
FY 2015	<u>Improving fuel economy for the current tactical ground fleet</u> through automation/smart cruise control, auxiliary electrification, thermally efficient cylinders, and modeling & simulation (M&S) for lightweighting
FY 2016	Increasing the operational energy performance of <u>unmanned systems</u> for the Pacific including air, surface, undersea, and ground systems
FY 2017	1) <u>Thermal and power management technologies</u> for high pulse power systems 2) <u>Wireless transmission</u> of energy in the far-field

FY 2018-2025 for further development and fielding of these new technologies. Another program partnered with the Advanced Research Project Agency-Energy (ARPA-E) developed disruptive energy efficient ECU designs. The program successfully demonstrated a Stirling based ECU with an efficiency improvement of 18 percent and a membrane dehumidification system with energy savings of 10 percent. To continue this program, the Navy and ARPA-E are funding approximately \$7.4 million for either further development or for a proof of concept demonstration of three of the technologies. A third program developed an improved Containerized Living Unit (CLU) with an energy efficiency improvement of 54 percent, a SuperCLU with an energy efficiency improvement of 82 percent, and a Net Zero SuperCLU. The SuperCLUs are currently being purchased and deployed, and the Navy has funded \$ 856,000 to finish testing the SuperCLU

and further development of the NetZero SuperCLU.

The FY 2013 programs are largely complete and focused on the use of consortia as venues for organizations inside and outside of Government to cooperate on specific operational energy challenges. The topics of the consortia programs were: Soldier and small unit power; expeditionary outpost energy planning and control, and operational energy education; reducing aircraft aerodynamic drag; and developing open standards for tactical microgrids. The Soldier and Small Unit Power Consortium is taking a comprehensive systems engineering approach to reduce the weight, type, and number of batteries carried by dismounted troops and small units. The program developed analysis tools, test beds, and wearable measurement systems that the Army will continue to use as enduring capabilities. Another consortium, the Tactical Microgrids Standards Consortium is developing, testing, publishing, and maintaining military specifications for deployable tactical microgrids. The tactical microgrids standards have been developed with Government and private industry participation, and the consortium has started the process of testing and verification. The Army has incorporated the emerging tactical microgrid interoperability standards into their future plans and will maintain them once they are complete.

The six programs started in FY 2014 focused on analytical methods and tools addressing operational energy issues throughout the Department's planning, requirements, and management processes. The Marine Corps is leading a multiservice team developing an expeditionary energy module for the Synthetic Theater Operations Research Model campaign analysis tool. In another program, the USPACOM is leading an effort J-DEPLOI to insert operational energy factors into the Joint Operational Planning Process, dramatically improving mission planning. The Air Force is developing energy-related cost/benefit and analytical tools for the airlift and aerial refueling fleets to allow evaluation of fuel logistics effectiveness and resiliency. The Naval Surface Warfare Centers Carderock and Dahlgren are also coordinating on the development of a computer model that examines operational energy requirements in maritime combat scenarios. Lastly, the Army analytical community, through the Operational Energy Analysis Task Force, is developing models and methodologies to examine the effect of operational energy on mission effectiveness. These programs have made significant progress and are continuing to develop and test their models, build scenarios, and acquire energy consumption and logistical data.

For FY 2015, the Army Tank Automotive Research, Development and Engineering Center (TARDEC) expanded their work with the Department of Energy (DOE) Vehicles Technology Office through the Advanced Vehicle Power Technology Alliance (AVPTA) by working together on the *Improving Fuel Economy for the Current Ground Tactical Fleet Program*. This program aims to reduce fuel consumption of the current tactical ground vehicle fleet, increase the range of vehicles and time on station, and decrease the number of fuel convoys at risk. The four focus areas of the program include automation/smart cruise control, auxiliary electrification, thermally efficient cylinders, and vehicle weighting through the use of (M&S). These programs have

completed most of their contract awards and are in the process of setting up their test facilities, determining baselines, performing system development, and beginning initial testing of their proposed technologies.

Another FY 2015 program, the Joint Infantry Company Prototype, is a two-year Marine and Army program combining kinetic energy harvesting technology development efforts with operational testing at the company level to decrease battery weight carried by Warfighters and extend operational reach. In FY 2016, this program performed small scale user evaluations with multiple units, conducted a human factors study on the kinetic harvesters, and continued to improve M&S data. OECIF is also supporting the USPACOM Joint Deployable Waste to Energy Community of Interest by providing funding for concept of operations and requirements development, development of testing protocols, and testing.

Using the additional FY 2015 funding provided by Congress, OECIF started several shorter-term projects to complement existing OECIF programs or explore new directions. These include the following efforts:

- Develop new Soldier power distribution equipment and a light ultra-capacitor substitute for radio batteries;
- Quantify the cybersecurity threat to energy industrial control systems and how the Department might protect itself;
- Reduce ground-based fuel consumption in austere environments by leveraging modern behavioral modification techniques;
- Develop and test a membrane-based dehumidification system to reduce the air conditioning energy consumption of ground forces and ships in dock;
- Explore design and analysis tools for new heat exchangers for waste heat recovery and develop a novel heat exchanger for turbine waste heat;
- Demonstrate energy harvesting small, unmanned aerial vehicles;
- Establish an instrumented maritime testbed program to demonstrate and speed adoption of emerging, maritime energy-saving technologies in a shipboard environment; and
- Comparatively assess alternative federation methods (manual versus automated) for modules, simulations, and tools used by the Department when conducting operational energy related analyses.

At the end of FY 2016, these programs are in various stages with some complete and beginning follow-on work and others still progressing.

The six new programs started in FY 2016 reflect a shift within OECIF from an emphasis on contingency bases to one on mobile platforms for the Pacific. These programs will improve the operational energy performance of unmanned air, sea and ground systems that could be used

in the Pacific. One program will try to demonstrate a 15 percent reduction in fuel burn and a 25 percent increase in takeoff and cruise horsepower for the MQ-9 Reaper engine by achieving increases in compressor and turbine efficiency. Another program will do prototype system tests of an aluminum-water-thermal/electric power plant to mature the technology from its current proof of concept stage for use in the Navy's Large Displacement Unmanned Undersea Vehicle. A third program will extend and expand prior research in undersea energy harvesting by exploiting hydrothermal vents, an oceanographic feature where a fissure occurs on the sea floor, from which geothermally-heated water flows. The FY 2016 programs had their kickoff in late FY 2016 and have continued to ramp up. Additionally, an FY 2016 one-year Congressional plus-up funded four additional short-term programs focused on training and education.

The themes for FY 2017 OECIF were improving the operational energy performance of thermal and power management technologies for high pulse power systems, and the wireless transmission of energy in the far-field. The selection process is ongoing and these new starts will be addressed in the FY 2017 report.

Appendix D: FY 2016 Operational Energy Initiatives (Dollars in Thousands)

**Table 7. Air Force FY 2016 Operational Energy Initiatives
(Dollars in Thousands)**

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Air Force	Defense Research Sciences	Bioenergy and Biofuels Research	To develop new methods to slit and store hydrogen, turn CO2 into fuels using solar energy and to produce hydrogen with photosynthetic molecules	Diversify Supply	Science and Technology	3600	01	0601102F	1,213	780	4,020
Air Force	Defense Research Sciences	DDD Applications Systems (formerly Computational Intelligence)	Optimizing efficiency through computational data decisions with regard to which data to absorb, when it should be absorbed, and how it should be absorbed.	Reduce Demand	Science and Technology	3600	01	0601102F	620	780	4,020
Air Force	Defense Research Sciences	Novel Power and Energy Efficient Systems	Determine if carbon nanostructures may lead to the discovery of highly efficient photovoltaics, thermoelectrics, and new super conductors	Reduce Demand	Science and Technology	3600	01	0601102F	13,751	4,900	25,100
Air Force	Defense Research Sciences	Fuel Chemistry and Combustion M&S	To develop detailed and reduced mechanisms for the combustion of surrogates of petroleum fuels	Diversify Supply	Science and Technology	3600	01	0601102F	20,300	490	2,485
Air Force	University Research Initiative	Novel Power and Energy Efficient Systems	Develop carbon nanostructures for new logic gates, highly efficient photovoltaics, thermoelectrics, and fuel cells	Diversify Supply	Science and Technology	3600	01	0601103F	534	4,500	12,000
Air Force	University Research Initiative	Fuel Chemistry and Combustion M&S	To develop detailed and reduced mechanisms for the combustion of surrogates of petroleum fuels	Diversify Supply	Science and Technology	3600	01	0601103F	4,193	1,500	5,625
Air Force	Materials	2700 Deg F SiC-SiC Composites for Hot Turbines	Develop and predict behavior and life of SiC/SiC ceramic disk composites for ADVENT and HEETE engine demonstrators	Reduce Demand	Science and Technology	3600	02	0602102F	790	4,263	14,705
Air Force	Materials	Flexible Materials & Devices	Develop new materials and architectures for advanced energy and power devices	Reduce Demand	Science and Technology	3600	02	0602102F	2,293	2,335	11,882
Air Force	Adv. Mat. for Weapon Systems	Next Generation Turbine Engine Disk	Demonstrate improved alloys, process and life prediction methods for engine disks	Reduce Demand	Science and Technology	3600	03	0603112F	99	1,576	17,670
Air Force	Materials	Computer Methods for Composite Materials	Accelerate materials design/development/test cycle for energy efficient aircraft design	Diversify Supply	Science and Technology	3600	02	0602102F	2,462	7,686	9,339
Air Force	Aerospace Vehicle Technologies	Legacy Fleet Energy Efficiency	Develop fuel burn reduction technologies for the legacy and future fleets	Reduce Demand	Science and Technology	3600	02	0602201F	2,674	2,744	8,064
Air Force	Materials	Materials for Compact Power	Develop high energy density capacitor materials	Diversify Supply	Science and Technology	3600	02	0602102F	2,462	0	0

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Air Force	Aerospace Propulsion	Highly Efficient Embedded Turbine Engine (HEETE)	Develop fuel efficient large fan/jet propulsion technologies supporting extreme endurance and range	Reduce Demand	Science and Technology	3600	02	0602203F	5,110	1,209	1,209
Air Force	Aerospace Propulsion	Adaptive Engine Technology Development (AETD)	Mature ADVENT technologies and accelerate EMD with preliminary design and risk reduction	Reduce Demand	Science and Technology	3600	02	0602203F	14,028	518	518
Air Force	Aerospace Propulsion	Efficient Small Scale Propulsion (ESSP)	Develop 10X propulsion capability for small engines that increase thrust to weight and decrease specific fuel consumption	Reduce Demand	Science and Technology	3600	02	0602203F	3,208	3,100	13,900
Air Force	Aerospace Propulsion	Integrated Vehicle Energy Tech (INVENT)	Develop an integrated suite of efficient, mission adaptive, robust electrical and thermal management systems to reduce aircraft energy demand	Reduce Demand	Science and Technology	3600	02	0602203F	9,424	3,799	8,752
Air Force	Aerospace Propulsion	Fuel Assessment and EVAL	Evaluate advanced fuels for performance, environmental impact and system opns.	Diversify Supply	Science and Technology	3600	02	0602203F	7,245	5,036	26,137
Air Force	Aero TECH Development/ Demonstration	Legacy Fleet Energy Efficiency	Demonstrate improved alloys, process and life prediction methods for engine disks	Reduce Demand	Science and Technology	3600	03	0603211F	333	1,600	2,688
Air Force	Advanced Materials for Weapon Systems	2700 Deg F SiC-SiC Composites for Hot Turbines	Demonstrate SiC/SiC ceramic disk composites for ADVENT and HEETE engine demonstrators	Reduce Demand	Science and Technology	3600	03	0603112F	1,928	4,516	12,824
Air Force	Aerospace Technology Development/ Demonstration	Light Weight and Advanced Composite Structures	Demonstrate light weight composite structures to reduce weight, manufacturing cost and are air worthiness certifiable	Reduce Demand	Science and Technology	3600	03	0603211F	1,500	1,300	2,200
Air Force	Aerospace Propulsion and Power Technology	Fuel Assessment and Evaluation	Demonstrate fuels for performance, environmental impact and system operations	Diversify Supply	Science and Technology	3600	03	0603216F	2,300	2,286	11,659
Air Force	Aerospace Propulsion and Power Technology	Integrated Vehicle Energy Tech (INVENT)	Demonstrate advanced aircraft subsystem components for on-demand subsystems	Reduce Demand	Science and Technology	3600	03	0603216F	4,189	2,690	2,690
Air Force	Aerospace Propulsion and Power Technology	Adaptive Engine Technology Development (AETD)	Mature ADVENT Technologies and accelerate EMD with preliminary design and risk reduction	Reduce Demand	Science and Technology	3600	03	0603216F	2,545	45,800	45,800
Air Force	Human Effectiveness Applied Research	Learning management tech. for distributed mission operations and live virtual and constructive operations	Develop and demonstrate interactive toolset for live virtual training	Reduce Demand	Science and Technology	3600	03	0603456F	3,100	3,200	23,800

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Air Force	AMC Command & Control	Mission Indexed Flying (MIF)	Procured COTS Mission Indexed Flying (MIF) software for KC-10, & KC-135 fleets to use inflight to reduce fuel consumption by flying optimum altitudes and speeds; also procured for C-17 and C-5 fleets using TWCF funds	Reduce Demand	Legacy Force Upgrade/Improvements	3400	02	0401840F	37	36	150
Air Force	C-5 Airlift Squadrons	ACARS C-5 A/B/C/M Fleet Block Upgrade	This is a fuel efficiency initiative for updating the C-5 ACARS standard message set for fuel analysis. The modification is ongoing. Once completed the AMC Fuel Efficiency Office will track and analyze fuel usage.	Reduce Demand	Measuring, Monitoring, and Data Collection	3010	05	0401119F	14,616	0	0
Air Force	KC135	ACARS KC135 (3400)	This is a fuel efficiency initiative for updating the KC 135 ACARS standard message set for fuel analysis. The modification is ongoing. Once completed the AMC Fuel Efficiency Office will track and analyze fuel usage.	Reduce Demand	Measuring, Monitoring, and Data Collection	3400	02	0401218F	500	0	0
Air Force	KC135	ACARS KC135 (3400)	This is a fuel efficiency initiative for updating the KC 135 ACARS standard message set for fuel analysis. The modification is ongoing. Once completed the AMC Fuel Efficiency Office will track and analyze fuel usage.	Reduce Demand	Measuring, Monitoring, and Data Collection	3400	02	0401218F	500	0	0
Air Force	C-5 Airlift Squadrons	C-5M Procurement	Fuel efficiency was not the primary driver for the RERP modification and with only 9 aircraft modified at this point there is not enough data to predict savings in the out years	Reduce Demand	Legacy Force Upgrade/Improvements	3010	05	0401119F	317,466	0	0
Air Force	KC-135s	KC-135 Engine Upgrades	CFM Propulsion Upgrade Program (C-PUP) inserts modern technology into F-108 engine. Initiative will change/upgrade the high pressure (HP) turbine nozzle, turbine shroud assembly, turbine blades and compressor blades/vanes.	Reduce Demand	Legacy Force Upgrade/Improvements	3400	02	0401218F	106,000	24,800	50,400
Air Force	Dominant Information Sciences and Methods	Robust and Secure Systems	Attack resistant and energy efficient processor	Reduce Demand	Science and Technology	3600	02	0602788F	2,604	4,466	22,514
Air Force	Dominant Information Sciences and Methods	Energy Efficient Computing	Develop next generation energy efficient processing capabilities	Reduce Demand	Science and Technology	3600	02	0602788F	2,584	0	0
Air Force	Dominant Information Sciences and Methods	Agile Intelligent Systems	Energy efficient, multifunction processing	Reduce Demand	Science and Technology	3600	02	0602788F	255	3,566	20,905

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Air Force	Dominant Information Sciences and Methods	Agile Intelligent Systems	Energy efficient, multifunction processing	Reduce Demand	Science and Technology	3600	03	0603788F	0	611	3,875
Air Force	SAF/IEN Funding	SAF/IEN Strategic Priorities	Develop policy and framework to support OE	Future Force	Doctrine, Tng, Education	3400	04	0905015F	2,142	1,478	6,960
Air Force	Aerospace Propulsion	Adaptive Engine Technology Development (AETD) and Adaptive Engine Transition Program	Mature adaptive engine technologies to TRL 7 for future integration and flight.	Reduce Demand	Science and Technology	3600	04	0604858F	116,006	243,670	2,088,213
Air Force	Aerospace Vehicle Technologies	Composite Certification	Develop Tools to apply Air Force Damage Tolerance Methods to Composite Structures. Develop Life Prediction Tools for Composite Airframes. Tools to understand critical design data earlier	Reduce Demand	Science and Technology	3600	02	0602201F	8,677	8,648	51,833
Air Force	Aerospace Vehicle Technologies	Next Generation Mobility Advanced Structures	Develop enhanced systems capability by dramatically increasing reach, effectiveness and responsiveness for legacy and future mobility A/C	Reduce Demand Initiatives	Science and Technology	3600	02	0602201F	94	1,841	15,592
Air Force	Aerospace Vehicle Technologies	Surfing Aircraft Vortices for Energy (SAVE) Formation Flight Advanced Technology	Fly aircraft in formation, autonomously, at safe distances, to save energy, like migratory birds. Application is C-17A (existing hardware enables software only solution only)	Reduce Demand	Science and Technology	3600	02	0602201F	230	250	1,255
Air Force	Aerospace Vehicle Technologies	Legacy Fleet Energy Efficiency	Develop fuel burn reduction technologies for legacy and future transport/tanker aircraft	Reduce Demand	Science and Technology	3600	02	0602201F	94	1,233	5,527
Air Force	Aerospace Vehicle Technologies	Next Generation Mobility	Develop enhanced systems capability by dramatically increasing reach, effectiveness and responsiveness for legacy and future mobility A/C	Reduce Demand	Science and Technology	3600	02	0602201F	8,549	7,323	51,878
Air Force	Aerospace Vehicle Technologies	(SAVE) Formation Flight Advanced Technology	Fly aircraft in formation, autonomously, at safe distances, to save energy, like migratory birds. Application is C-17A (existing hardware enables software only solution only)	Reduce Demand	Science and Technology	3600	02	0602201F	450	550	850
Air Force	Aerospace Propulsion	Power Management and Distribution Product Area	Improved stability, efficiency and protection for current and future electrical power systems, including wider temperature tolerance	Reduce Demand	Science and Technology	3600	02	0602203F	4,733	5,867	33,257
Air Force	Aerospace Propulsion	Aircraft Energy Storage Product Area	Develop safe, compact, high-power energy storage for small UAS to large aircraft.	Reduce Demand	Science and Technology	3600	02	0602203F	7,533	3,155	36,628

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Air Force	Aerospace Propulsion	Aircraft Thermal Systems Product Area	Fundamental and applied thermal acquisition, transport, rejection & storage R&D to address current and future aircraft performance limitations	Reduce Demand	Science and Technology	3600	02	0602203F	4,051	8,012	25,309
Air Force	Aerospace Propulsion	Electro- MECH Power Systems Product Area	Technologies to improve the size, weight, and energy efficiency of electro-mechanical energy transfer processes.	Reduce Demand	Science and Technology	3600	02	0602203F	930	4,183	25,880
Air Force	Aerospace Propulsion	Computational Engineering	Address the Air Force need to assess military air platform capabilities through the creation of a validated, integrated, dynamical, tip-to-tail modeling capability	Reduce Demand	Science and Technology	3600	02	0602203F	2,722	3,774	15,828
Air Force	Aircraft Sustainment	Composite Certification	Develop Tools to apply Air Force Damage Tolerance Methods to Composite Structures. Develop Life Prediction Tools for Composite Airframes. Tools to understand critical design data earlier	Reduce Demand	Science and Technology	3600	03	0603199F	2,501	4,515	37,598
Air Force	Aero. Tech Development/ Demonstration	Next Generation Mobility	Demonstrate light weight composite structures to reduce weight, manufacturing cost and are air worthiness certifiable	Reduce Demand	Science and Technology	3600	03	0603211F	0	5,419	48,114
Air Force	Aerospace Technology Development/ Demonstration	(\$SAVE) Formation Flight Advanced Technology	Fly aircraft in formation, autonomously, at safe distances, to save energy, like migratory birds. Application is C-17A (existing hardware enables software only solution only)	Reduce Demand	Science and Technology	3600	03	0603211F	2,345	1,639	2,328
Air Force	Aerospace Technology Development/ Demonstration	Power Management and Distribution	Improved stability, efficiency and protection for current and future electrical power systems, including wider temperature tolerance	Reduce Demand	Science and Technology	3600	03	0603216F	8,122	624	12,942
Air Force	Aerospace Technology Development/ Demonstration	Aircraft Thermal Systems Product Area	Fundamental and applied thermal acquisition, transport, rejection & storage R&D to address current and future aircraft performance limitations	Reduce Demand	Science and Technology	3600	03	0603216F	802	1,495	6,026
Air Force	Aerospace Technology Development/ Demonstration	INVENT Spiral III	Demonstrate component and subsystem technologies for a fully integrated propulsion, power, & thermal management system that enables next generation game changing high power demand capabilities	Reduce Demand	Science and Technology	3600	03	0603216F	0	0	22,206
Air Force	Aero. Tech Development/ Demonstration	Electro-Mechanical Power Systems	Technologies to improve the size, weight, and energy efficiency of electro-mechanical energy transfer processes.	Reduce Demand	Science and Technology	3600	03	0603216F	802	1,559	4,240
Air Force	Materials	Efficient Propulsion	Develop new materials and architectures for advanced energy and power devices	Reduce Demand	Science and Technology	3600	03	0603112F	0	0	9,868
								TOTAL AIR FORCE OE	721,646	445,322	2,867,263

**Table 8. Army 2016 Operational Energy Initiatives
(Dollars in Thousands)**

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Army	Contingency Base Infrastructure (CBI)	Contingency Base Infrastructure (CBI)	Optimize recommendations for materiel used to establish, maintain, and operate contingency basing	Diversify Supply	Legacy Force Upgrade/Improvements	2040	05	0604804A	982	2,541	10,861
Army	Jt. Opnl. Energy Init. (JOEI)	Modeling and Simulation	Holistic approach to the evaluation of Operational Energy related impacts, systems and improvements	Future Force	OE Analysis and Modeling	2040	04	0603804A	2,500	1,500	4,500
Army	Joint Light Tactical Vehicle	Joint Light Tactical Vehicle (JLTV)	More efficient light vehicle - ~30% improvement in stationary fuel consumption over the baseline HMMWV	Reduce Demand	Future Force Development	2040	05	0605812A	7,665	0	677
Army	Joint Light Tactical Vehicle	Joint Light Tactical Vehicle (JLTV)	More efficient light vehicle - ~30% improvement in stationary fuel consumption over the baseline HMMWV	Reduce Demand	Future Force Development	2035	01	0216300A	6,930	35,975	342,767
Army	Stryker	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network.	Reduce Demand	Legacy Force Upgrade/Improvements	2040	07	0203735A	104,200	90,800	199,900
Army	Stryker	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network	Reduce Demand	Legacy Force Upgrade/Improvements	2033	01	0211702A	537	172,300	1,957,080
Army	Modular Fuel System (MFS)	Modular Fuel System (MFS)	More efficient fuel distribution in the battlespace	Diversify Supply	Current Operations	2035	03	0216300A	26,729	16,267	63,151
Army	Force Provider	Improved Energy Efficiency	Base Camp Integration Lab (BCIL), Fort Devens / Net Zero / Zero Footprint	Reduce Demand	Future Force Development	2040	04	0603804A	2,240	3,788	16,635
Army	Force Provider	Improved Energy Efficiency	Base Camp Integration Lab (BCIL) Fort, Devens / Net Zero / Zero Footprint	Reduce Demand	Current Operations	2040	05	0604804A	2,130	1,575	13,878
Army	Force Provider	Improved Energy Efficiency	Modifications to In-Service Equipment, Force Provider MoD 7 - Purchase of liners, shades, doorways, micro-grids and Light Emitting Diodes (LED) lighting resulting in a 35% reduction in fuel demand.	Reduce Demand	Legacy Force Upgrade/Improvements	2035	03	0216300A	26,565	30,258	106,578
Army	Force Provider	Improved Energy Efficiency	Improved Force Provider - Purchase of liners, shades, Light Emitting Diode (LED) lighting, micro-grids and shower water re-use systems to reduce fuel usage by 50% and water by 75%.	Reduce Demand	Current Operations	2035	03	0216300A	16,590	18,830	18,830
Army	Battlefield Kitchen	Improved Energy Efficiency	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Reduce Demand	Future Force Development	2040	04	0603747A	537	280	760
Army	Battlefield Kitchen	Improved Energy Efficiency	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Reduce Demand	Future Force Development	2035	05	0604713A	0	0	4,190
Army	Battlefield Kitchen	Improved Energy Efficiency	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Reduce Demand	Future Force Development	2035	03	0216300A	0	0	4,955

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Army	Combat Vehicle Improvement	Improved Bradley	More efficient Bradley - Research and Development effort to improve Bradley fuel efficiency by 3%	Reduce Demand	Legacy Force Upgrade/Improvements	2040	07	0203735A	1,000	500	700
Army	Combat Vehicle Improvement	Improved Bradley	More efficient Bradley - The Bradley improved transmission generate an overall fuel reduction of 3%	Reduce Demand	Legacy Force Upgrade/Improvements	2033	01	0211702A	49,200	26,300	501,600
Army	Combat Vehicle Improvement	Improved Abrams	More efficient Abrams - Research & Development effort to improve Abrams fuel efficiency by 24%.	Reduce Demand	Legacy Force Upgrade/Improvements	2040	07	0203735A	1,415	269	504
Army	Combat Vehicle Improvement	Improved Abrams	More efficient Abrams - The Abrams Auxiliary Power Unit (APU) will generate an overall fuel savings of 24%.	Reduce Demand	Legacy Force Upgrade/Improvements	2033	01	0211702A	0	2,800	18,100
Army	Early Entry Fluid Distribution System (E2FDS)	More efficient fuel/non-potable water distribution	More efficient fuel/non-potable water distribution in the battlespace	Diversify Supply	Current Operations	2040	04	0603804A	2,795	3,935	7,735
Army	(E2FDS)	More efficient fuel/non-potable water distribution	More efficient fuel/non-potable water distribution in the battlespace	Diversify Supply	Current Operations	2040	05	0604804A	1,884	2,713	7,413
Army	Advanced Medium Mobile Power Source (AMMPS)	Advanced Mobile Medium Power Sources (AMMPS) Generator Sets	Purchase of the improved medium generator sets using 21% less fuel	Reduce Demand	Legacy Force Upgrade/Improvements	2035	03	0216300A	95,724	115,844	491,436
Army	HIPPO Water Distribution System	Improved Energy Efficiency	More efficient water distribution	Reduce Demand	Legacy Force Upgrade/Improvements	2035	03	0216300A	12,348	14,429	39,266
Army	Improved Power Distribution Illumination Systems Electrical (IPDISE)	Improved Energy Efficiency	More efficient power distribution	Reduce Demand	Legacy Force Upgrade/Improvements	2040	05	0604804A	1,000	2,040	3,894
Army	(IPDISE)	Improved Energy Efficiency	More efficient power distribution	Reduce Demand	Legacy Force Upgrade/Improvements	2035	03	0216300A	16,058	2,500	62,091
Army	Small Tactical Electrical Power (STEP)	Improved Small Generator	Small Tactical Electrical Power (STEP)	Reduce Demand	Legacy Force Upgrade/Improvements	2040	05	0604804A	1,362	7,822	19,103
Army	(STEP)	Improved Small Generator	Small Tactical Electric Power (STEP)	Reduce Demand	Legacy Force Upgrade/Improvements	2035	03	0216300A	3,408	6,280	63,624
Army	Improved Environmental Control Unit (IECU)	Improved Energy Efficiency	Military air conditioners with supplemental heaters	Reduce Demand	Legacy Force Upgrade/Improvements	2040	05	0604804A	0	976	10,478

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Army	(IECU)	Improved Energy Efficiency	Heaters and Improved Environmental Control Unit (IECU) family	Reduce Demand	Legacy Force Upgrade/Improvements	2035	03	0216300A	18,012	18,876	60,288
Army	Improved Aircraft Engine	Improved Aircraft Engine	More efficient helicopter engine - ITEP enters Milestone A in 1QFY14 - Army expects 13% to 22% fuel reduction from current Blackhawk/Apache engines. Flies at higher altitudes, in hotter temperatures and increased range. 35% less MAINT cost.	Reduce Demand	Legacy Force Upgrade/Improvements	2040	07	0203744A	39,328	49,247	640,796
Army	Aviation Simulator	Aviation Combined Arms Tactical Trainer (AVCATT)	Simulators for aviation asset collective training	Reduce Demand	Current Operations	2040	05	0604780A	11,671	1,225	26,920
Army	Aviation Simulator	Simulator for the Apache helicopter	Simulator for the Apache Helicopter	Reduce Demand	Current Operations	2031	01	0210100A	15,098	15,385	80,506
Army	Aviation Simulator	(AVCATT)	Simulators for aviation asset collective training	Reduce Demand	Current Operations	2035	03	0219900A	14,440	31,274	145,123
Army	Aviation Simulator	Simulator for the Blackhawk HELO	The Blackhawk simulator saves fuel and enhances safety	Reduce Demand	Current Operations	2031	01	0210101A	21,765	22,199	76,519
Army	Aviation Simulator	Simulator for the Chinook Helicopter	Chinook Transportable Flight Proficiency Simulator saves (TFPS)	Reduce Demand	Current Operations	2031	01	0210104A	12,947	13,364	66,597
Army	Improved Large Generator	Improved Large Generator	Large Advanced Mobile Power Sources (LAMPS)	Reduce Demand	Legacy Force Upgrade/Improvements	2035	03	0216300A	0	25,380	90,736
Army	Expeditionary Water Packaging System (EWPS)	Reduced reliance on shipping water into theater	EWPS provides localized production of bottle water	Diversify Supply	Current Operations	2035	03	0216300A	1,615	3,025	15,847
Army	Early Entry Fluid Distribution System (E2FDS)	More efficient fuel/non-potable water distribution	More efficient fuel/non-potable water distribution in the battlespace	Diversify Supply	Current Operations	2035	03	0216300A	0	0	35,328
Army	Small Unit Power	Small Unit Power (SUP) Platoon Power Generation	Platoon Power Generation	Diversify Supply	Batteries	2040	05	0604827A	0	5,411	40,690
Army	Small Unit Power	Soldier Power	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Diversify Supply	Batteries	2035	03	0211700A	11,144	51,334	247,898
Army	In-house Laboratory Independent Research	Advanced Mobility - ILIR - TARDEC 02	TARDEC in house basic research for ground vehicles to support improved system mobility, reliability, and survivability	Reduce Demand	Science and Technology	2040	01	0601101A	1,496	1,452	6,570

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Army	Defense Research Sciences	Vehicle Propulsion & Power Research 01	Basic research to increase the performance of small air-breathing engines and power-trains for air and/or ground vehicles; new materials to withstand the higher temperature regimen. Flow physics and the mechanical behavior tools.	Reduce Demand Initiatives	Science and Technology	2040	01	0601102A	2,407	2,431	12,544
Army	Defense Research Sciences	High Efficiency Propulsion Research 02	Research to develop tools and methods to enhance the reliability and fuel efficiency of small engines for air and ground vehicles and to enable the use of heavy fuels.	Reduce Demand	Science and Technology	2040	01	0601102A	1,700	1,730	8,947
Army	Defense Research Sciences	Propulsion System Tech 01	Basic research in non-linear ground vehicle control algorithms, using off-road terrain characteristics; and unique mobility approaches, using advanced analytical and experimental procedures.	Reduce Demand	Science and Technology	2040	01	0601102A	701	707	3,662
Army	Defense Research Sciences	Engineered Biotechnology 05	Basic research in multi-scale modeling approach to investigate biological systems to develop biologically-inspired sensors as well as bio-inspired power generation and storage techniques.	Diversify Supply	Science and Technology	2040	01	0601102A	2,009	3,014	18,552
Army	Defense Research Sciences	Novel Materials for Compact Power 05	Basic research on electronic materials and structures as well as technologies in energy harvesting and energetic materials, batteries and fuel cells to enable higher performance and more efficient electronic systems.	Reduce Demand	Science and Technology	2040	01	0601102A	2,299	2,696	13,368
Army	Defense Research Sciences	Electromagnetics & Solid State Electronics 21	Extramural basic research in Electromagnetics & Solid State Electronics	Reduce Demand	Science and Technology	2040	01	0601102A	2,599	2,646	13,684
Army	Defense Research Sciences	Propulsion, Energetics & Flight 27	Propulsion Energetics and Flight extramural basic research	Reduce Demand	Science and Technology	2040	01	0601102A	2,999	3,045	14,127
Army	Defense Research Sciences	Electrochemistry and Energy Conversion 52	Extramural basic research in electro-chem and energy conversion, power generation, energy storage, and power management components and software.	Reduce Demand	Science and Technology	2040	01	0601102A	5,598	5,700	29,472
Army	Aviation Technology	High Efficiency Engine Component Tech. 53	Applied research in high efficiency engine component technology for manned and unmanned rotary wing aircraft.	Reduce Demand	Science and Technology	2040	02	0602211A	3,083	0	0
Army	Aviation Technology	Advanced Concept Engine Components 58	Applied research in high efficiency engine component technology for manned and unmanned rotary wing aircraft.	Reduce Demand	Science and Technology	2040	02	0602211A	0	1,100	14,614
Army	Aviation Technology	Rotorcraft Transmission 62	Applied research in rotorcraft advanced drive system component technologies to support multi-speed transmissions, lighter weight gearboxes, and reduced costs, while improving reliability and maintainability.	Reduce Demand	Science and Technology	2040	02	0602211A	2,000	2,500	17,511

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Army	Aviation Technology	Air Vehicle Propulsion & Power Technology 23	Applied Research for rotary wing aircraft in high temperature materials, advanced models for flow physics and improved methods for predicting propulsion system mechanical behavior to increase fuel efficiency and reduce propulsion system weight.	Reduce Demand	Science and Technology	2040	02	0602211A	2,024	2,126	13,985
Army	Combat Vehicle and Automotive Technology	NAC Program - Power, Energy and Mobility 01C	Ground vehicle applied research in dual use power, energy, and mobility technologies focusing on: light weight composite materials, electrification of engine accessories, alternative fuels, hybrid vehicle architectures, and compact electrical power genera	Reduce Demand	Science and Technology	2040	02	0602601A	4,234	4,236	20,891
Army	Combat Vehicle and Automotive Technology	NAC Program - Power, Energy and Mobility STO 01CV	Ground vehicle applied research in dual use power, energy, and mobility technologies focusing on: light weight composite materials, electrification of engine accessories, alternative fuels, hybrid vehicle architectures, and compact electrical power genera	Reduce Demand	Science and Technology	2040	02	0602601A	0	0	947
Army	Combat Vehicle and Automotive Technology	NAC Program - Dual Use Technologies 01E	Ground vehicle applied research in ground vehicle technologies with both military and commercial applications such as renewable energy technologies, electrical power management between vehicles and the grid, alternative fuels, and advanced vehicle network	Reduce Demand	Science and Technology	2040	02	0602601A	10,741	11,502	55,100
Army	Combat Vehicle and Automotive Technology	NAC Program - Dual Use Technologies STO 01EV	Ground vehicle applied research in ground vehicle technologies with both military and commercial applications such as renewable energy technologies, electrical power management between vehicles and the grid, alt. fuels, and advanced vehicle network	Reduce Demand	Science and Technology	2040	02	0602601A	661	0	3,919
Army	Combat Vehicle and Automotive Technology	Electrical Power Systems 86	Ground vehicle applied research in electrical power systems--high temperature and efficient power generation components using high operating temperature switching devices and advanced electrical generation components	Reduce Demand	Science and Technology	2040	02	0602601A	0	159	5,682
Army	Combat Vehicle and Automotive Technology	Electrical Power Systems 86I	Ground vehicle applied research in electrical power systems--high temperature and efficient power generation components using high operating temperature switching devices and advanced electrical generation components	Reduce Demand	Science and Technology	2040	02	0602601A	1,410	1,378	5,516

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Army	Combat Vehicle and Automotive Technology	Electrical Power Systems STO 86V	Ground vehicle applied research in electrical power systems--high temperature and efficient power generation components using high operating temperature switching devices and advanced electrical generation components	Reduce Demand	Science and Technology	2040	02	0602601A	1,413	1,046	2,074
Army	Combat Vehicle and Automotive Technology	Energy Storage Research 87	Ground vehicle applied research in energy storage devices such as advanced chemistry batteries and ultra capacitors for starting, lighting, and ignition and silent watch reqs for powering vehicle electronics and comms systems with main engine off.	Reduce Demand	Science and Technology	2040	02	0602601A	0	0	2,587
Army	Combat Vehicle and Automotive Technology	Energy Storage Research STO 87IV	Ground vehicle applied research in energy storage devices such as advanced chemistry batteries and ultra capacitors for starting, lighting, and ignition and silent watch reqs for powering vehicle electronics and comms systems with main engine off.	Reduce Demand	Science and Technology	2040	02	0602601A	0	839	3,694
Army	Combat Vehicle and Automotive Technology	Energy Storage Research STO 87SV	Ground vehicle applied research in energy storage devices such as advanced chemistry batteries and ultra capacitors for starting, lighting, and ignition and silent watch reqs for powering vehicle electronics and comms systems with main engine off.	Reduce Demand	Science and Technology	2040	02	0602601A	2,535	1,480	6,156
Army	Combat Veh. AUTO Tech	Ground Vehicle APU Research 88	Ground vehicle applied research in auxiliary power unit technology.	Reduce Demand	Science and Technology	2040	02	0602601A	33	1,315	6,108
Army	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research 88I	Ground vehicle applied research in auxiliary power unit technology.	Reduce Demand	Science and Technology	2040	02	0602601A	763	477	2,360
Army	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research STO 88V	Ground vehicle applied research in auxiliary power unit technology.	Reduce Demand	Science and Technology	2040	02	0602601A	2,256	117	4,124
Army	Combat Vehicle and Automotive Technology	High Voltage Power Generation Research 89	Ground vehicle applied research in high voltage power generation.	Reduce Demand	Science and Technology	2040	02	0602601A	0	0	2,594
Army	Combat Vehicle and Automotive Technology	High Voltage Power Generation Research STO 89SV	Ground vehicle applied research in high voltage power generation.	Reduce Demand	Science and Technology	2040	02	0602601A	478	1,218	3,328
Army	Combat Vehicle and Automotive Technology	High Voltage Power Generation Research STO 89V	Ground vehicle applied research in high voltage power generation.	Reduce Demand	Science and Technology	2040	02	0602601A	850	0	0

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Army	Combat Vehicle and Automotive Technology	Next Generation Engine Research 90	Ground vehicle applied research in a high power density low heat rejection, fuel efficient engine technology.	Reduce Demand	Science and Technology	2040	02	0602601A	0	0	3,052
Army	Combat Vehicle and Automotive Technology	Next Generation Engine Research STO 90V	Ground vehicle applied research in a high power density low heat rejection, fuel efficient engine technology.	Reduce Demand	Science and Technology	2040	02	0602601A	2,705	2,705	11,590
Army	Combat Vehicle and Automotive Technology	Pulse Power for Advanced Armors 96	Ground vehicle applied research in pulse power for future armor.	Diversify Supply	Science and Technology	2040	02	0602601A	0	0	3,726
Army	Combat Vehicle and Automotive Technology	Pulse Power for Advanced Armors 96I	Ground vehicle applied research in pulse power for future armor.	Diversify Supply	Science and Technology	2040	02	0602601A	1,676	0	0
Army	Combat Vehicle and Automotive Technology	Pulse Power for Advanced Armors STO 96IV	Ground vehicle applied research in pulse power for future armor.	Diversify Supply	Science and Technology	2040	02	0602601A	1,693	3,423	14,274
Army	Ballistics Technology	Disruptive Energetics and Propulsion Technologies 68	Applied research in energetics and energetics propulsion.	Reduce Demand	Science and Technology	2040	02	0602618A	0	0	15,022
Army	Electronics and Electronic Devices	Silicon Carbide Research-ARL 86A	Congressional Increase to develop Silicon Carbide technology for power management	Reduce Demand	Science and Technology	2040	02	0602705A	17,000	0	0
Army	Electronics and Electronic Devices	High Power and Energy Technologies 01	Applied research electronic materials, structures, and components for higher energy density and efficiency required by future Army systems such as electromagnetic armor, directed energy weapons, power grid protection, and other pulsed-power systems	Reduce Demand	Science and Technology	2040	02	0602705A	1,182	1,233	6,394
Army	Electronics and Electronic Devices	High Energy Laser Enabling Technologies for Tactical Directed Energy Weapons 03	Applied research in novel solid-state laser concepts, architectures, and components with the goal of providing technology to Army directed energy weapon developers.	Reduce Demand	Science and Technology	2040	02	0602705A	2,000	2,000	10,040
Army	Electronics and Electronic Devices	Electronic Components and Materials Research 09	Applied research in compact, high-efficiency, high-temp, high-power component technologies (semiconductor, magnetic, and dielectric devices) for hybrid-electric propulsion, electric power gen and conversion, and smart/micro-grid power distribution.	Reduce Demand	Science and Technology	2040	02	0602705A	3,000	3,234	17,435

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Army	Electronics and Electronic Devices	Pulsed Power Components and Systems Research 10	Applied research in energy storage capacitors, high voltage converters, semiconductor switches, & explosive based pulse generators, that improve pulsed-power components for applications such as EM armor, electronic fuze initiators, and electronic protect	Reduce Demand	Science and Technology	2040	02	0602705A	10	1,514	7,560
Army	Electronics and Electronic Devices	Power System Components Integration and Control Research 13	Applied research in electronic components and control strategies for high-power density and high efficiency power use in current and future platform sub-systems, vehicle, and micro-grid (installation) applications.	Reduce Demand	Science and Technology	2040	02	0602705A	599	1,837	10,508
Army	Electronics and Electronic Devices	Electronic Warfare/Electronic Attack/Directed Energy Technologies 14	Applied research in DE technology, electronic warfare (EW) survivability/lethality, and supporting high power components with the goal of enhancing the survivability/lethality of Army platforms.	Reduce Demand	Science and Technology	2040	02	0602705A	1,791	1,715	8,781
Army	Electronics and Electronic Devices	Tactical Power Generation 06	Soldier transportable power source applied research	Reduce Demand	Science and Technology	2040	02	0602705A	3,920	6,710	39,518
Army	Electronics and Electronic Devices	Energy Informed OPNS 07T	applied research for tactical power generation technology	Reduce Demand	Science and Technology	2040	02	0602705A	2,846	0	8,040
Army	Electronics and Electronic Devices	Energy Informed Operations STO 07TV	applied research for tactical power generation technology	Reduce Demand	Science and Technology	2040	02	0602705A	5,000	5,000	5,000
Army	Electronics and Electronic Devices	Lightweight Portable and Soldier Power Sources 42T	Applied research in soldier and portable power sources: batteries, fuel cells, generators.	Reduce Demand	Science and Technology	2040	02	0602705A	0	100	200
Army	Electronics and Electronic Devices	Efficient Compact Portable Power 68	Applied research in compact portable power sources	Reduce Demand	Science and Technology	2040	02	0602705A	863	862	4,457
Army	Electronics and Electronic Devices	Microsystem Power Components 69	Applied research in electronics and electronic components and devices for C4ISR applications and battlefield power and energy applications.	Reduce Demand	Science and Technology	2040	02	0602705A	1,375	1,375	7,100
Army	Electronics and Electronic Devices	Compact High Performance Thermal Mgmt 70	Applied Research in MEMS based components to improve power generation and micro-cooling technology for both dismounted Soldier other future applications.	Reduce Demand	Science and Technology	2040	02	0602705A	1,140	1,137	5,876
Army	Electronics and Electronic Devices	High Density E-Chem Sources & Storage 71	Applied research in higher energy density batteries and power sources	Reduce Demand	Science and Technology	2040	02	0602705A	2,784	2,784	14,378

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Army	Electronics and Electronic Devices	Logistic Fuel Reform & Processing 72	Applied research in reforming logistics fuel for fuel cell hydrogen	Reduce Demand	Science and Technology	2040	02	0602705A	1,188	1,187	6,132
Army	Elect. and Elect. Devices	Energy Harvesting Tech. 83	Applied research in soldier energy scavenging technology	Reduce Demand	Science and Technology	2040	02	0602705A	1,568	2,340	15,687
Army	Warfighter Advanced Technology	Digital Perception Measures and Metrics 43	Create, mature, and demonstrate data collection and analysis infrastructure to measure technology readiness level of Soldier borne software, hardware, and networking equipment.	Reduce Demand	Science and Technology	2040	03	0603001A	1,705	0	0
Army	Warfighter Advanced Technology	Situ. Awareness Displays: Integration & Portrayal 44	Soldier small unit Intelligence Surveillance & Reconnaissance (ISR) information portrayal providing actionable information for the Soldier and Small unit.	Reduce Demand	Science and Technology	2040	03	0603001A	0	0	10,474
Army	Warfighter Advanced Technology	Soldier and Small Unit Power and Energy Demand Management 45	Systematic examination of inherent energy inefficiencies and rethinking of innovative and new design approaches. Implement and demonstrate automatic and programmable prioritization of power usage by electronic devices to optimize power source duration	Reduce Demand	Science and Technology	2040	03	0603001A	0	2,317	9,172
Army	Warfighter Advanced Technology	Power Source Optimization for Small Unit Networked Electronics 46	Evaluate innovative Soldier power and energy sources for small unit networked electronics to include high energy/power conformal battery, advanced wearable hybrid fuel cell, and multi-fueled man pack power source	Reduce Demand	Science and Technology	2040	03	0603001A	0	0	4,127
Army	Aviation Advanced Technology	Next Generation Rotorcraft Transmission 15	Matures and demonstrates components, subsystems and systems for rotorcraft transmissions (both manned and unmanned)	Reduce Demand	Science and Technology	2040	03	0603003A	0	0	8,844
Army	Aviation Advanced Technology	Future Advanced Rotorcraft Drive System (FY11-15) 15A	Matures and demonstrates drive system components, subsystems and systems for rotorcraft (both manned and unmanned) that provide, improved aircraft & occupant survivability, reduced maintenance & sustainment costs, and greater performance.	Reduce Demand	Science and Technology	2040	03	0603003A	6,954	0	0
Army	Aviation Advanced Technology	Future Affordable Turbine Engine 03	Matures and demonstrates rotorcraft turbine engine technologies through design, fabrication, and evaluation of advanced engine components in order to improve the performance of turbine engines for rotorcraft.	Reduce Demand	Science and Technology	2040	03	0603003A	8,250	8,216	8,216
Army	Aviation Advanced Technology	Alternative Concept Engine 07	Advanced technology demonstration of power system technologies through design, fabrication, and evaluation of advanced engine components in order to improve the performance of turbine engines for rotorcraft.	Reduce Demand	Science and Technology	2040	03	0603003A	0	0	23,451

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Army	Weapons and Munitions Advanced Technology	Advanced Munition Power and Initiation Systems Demo (AMPIS) 41	Matures and demonstrates advanced technologies for future weapons power technology. The major effort under this project is the phased approach for mobile high power solid state laser (SSL) technology demonstrations.	Reduce Demand	Science and Technology	2040	03	0603004A	585	0	0
Army	Weapons and Munitions Advanced Technology	Thermal Mgmt Integration 05A	Matures and demonstrates thermal management technologies for future directed energy weapons technology.	Reduce Demand	Science and Technology	2040	03	0603004A	0	0	7,692
Army	Wpns. and Munitions Adv. TECH	Power Mgmt Integration 06A	Matures and demonstrates power management technologies for future directed energy weapons technology.	Reduce Demand	Science and Technology	2040	03	0603004A	0	0	6,136
Army	Combat Vehicle and Automotive Advanced Technology (AAT)	Alternative Fuels and Petroleum, Oil & Lubricants 51	Ground vehicle alternative fuels and petroleum, oil & lubricants advanced technology development	Diversify Supply	Science and Technology	2040	03	0603005A	0	0	6,315
Army	Combat Vehicle and AAT	Alternative Fuels and Petroleum, Oil & Lubricants STO 51TV	Ground vehicle alternative fuels and petroleum, oil & lubricants advanced technology development	Diversify Supply	Science and Technology	2040	03	0603005A	2,469	1,100	1,927
Army	Combat Vehicle and AAT	Efficient Powertrain Technology Integration 55	Ground vehicle Efficient Powertrain Technology Integration advanced technology development	Reduce Demand	Science and Technology	2040	03	0603005A	0	0	5,321
Army	Combat Vehicle and AAT	Efficient Powertrain Technology Integration STO 55V	Ground vehicle Efficient Powertrain Technology Integration advanced technology development	Reduce Demand	Science and Technology	2040	03	0603005A	5,357	5,000	19,793
Army	Combat Vehicle and AAT	Energy Storage Systems Development 57	Ground vehicle Energy Storage Systems advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	0	0	3,200
Army	Combat Vehicle and AAT	Energy Storage Systems Development STO 57IV	Ground vehicle Energy Storage Systems advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	150	404	2,534
Army	Combat Vehicle and AAT	Energy Storage Systems Development STO 57JV	Ground vehicle Energy Storage Systems advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	1,000	1,059	4,359
Army	Combat Vehicle and AAT	Energy Storage Systems Development STO 57V	Ground vehicle Energy Storage Systems advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	2,477	1,463	5,334

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Army	Combat Vehicle and Automotive Advanced Technology	Ground Vehicle APU System Development 58	Ground Vehicle APU System advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	767	1,389	7,687
Army	Combat Vehicle and Automotive Advanced Technology	Ground Vehicle APU System Development 58I	Ground Vehicle APU System advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	0	1,707	6,142
Army	Combat Vehicle and Automotive Advanced Technology	Ground Vehicle APU System Development STO 58IV	Ground Vehicle APU System advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	1,332	0	0
Army	Combat Vehicle and Automotive Advanced Technology	Ground Vehicle APU System Development STO 58V	Ground Vehicle APU System advanced technology Development	Reduce Demand	Science and Technology	2040	03	0603005A	547	0	0
Army	Combat Vehicle and Automotive Advanced Technology	High Voltage Power Generation Development 59	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	0	0	2,895
Army	Combat Vehicle and Automotive Advanced Technology	High Voltage Power Generation Development STO 59IV	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	2,778	2,909	11,810
Army	Combat Vehicle and Automotive Advanced Technology	Hybrid / High Power Vehicle Evaluations 60	Hybrid / High Power ground Vehicle technology Evaluations	Reduce Demand	Science and Technology	2040	03	0603005A	0	0	2,444
Army	Combat Veh. and Auto. Advanced Technology	Hybrid / High Power Vehicle Evaluations STO 60IV	Hybrid / High Power ground Vehicle technology Evaluations	Reduce Demand	Science and Technology	2040	03	0603005A	0	1,299	1,666
Army	Combat Vehicle and Automotive Advanced Technology	Hybrid / High Power Vehicle Evaluations STO 60V	Hybrid / High Power ground Vehicle technology Evaluations	Reduce Demand	Science and Technology	2040	03	0603005A	1,500	193	2,626

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Army	Combat Vehicle and Automotive Advanced Technology	High Performance Track Development 61	Ground vehicle high performance track development	Reduce Demand	Science and Technology	2040	03	0603005A	0	0	2,042
Army	Combat Vehicle and Automotive Advanced Technology	High Performance Track Development 61I	Ground vehicle high performance track development	Reduce Demand	Science and Technology	2040	03	0603005A	1,000	2,000	7,002
Army	Combat Vehicle and Automotive Advanced Technology	Advanced Suspension Development (Ride & Handling) 62	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	915	2,731	11,841
Army	Combat Vehicle and Automotive Advanced Technology	Advanced Suspension Development (Ride & Handling) STO 62V	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	757	273	680
Army	Combat Vehicle and Automotive Advanced Technology	Integration of Advanced Armors and Energy Weapons 65	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	0	0	4,839
Army	Combat Vehicle and Automotive Advanced Technology	Integration of Advanced Armors and Energy Weapons 65I	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	2,500	599	1,191
Army	Combat Vehicle and Automotive Advanced Technology	Integration of Advanced Armors and Energy Weapons STO 65IV	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	1,000	3,224	16,723
Army	Combat Vehicle and Automotive Advanced Technology	Powertrain/Energy Storage/Survivability Demonstrator STO DTAV	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	5,798	6,000	22,518

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Army	Combat Vehicle and Automotive Advanced Technology	Powertrain/Energy Storage/Survivability Demonstrator DTAZ	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603005A	5,202	5,000	32,704
Army	Combat Vehicle and Automotive Advanced Technology	Sustainability/Logistics Basing Power and Energy STO T4AV	This project assesses the impact of using emerging alternative fuels in tactical/ combat vehicles, tactical generator sets, and other deployable assets. Identifies changes needed in fuel specifications to implement alt. fuels into Army systems.	Diversify Supply	Science and Technology	2040	03	0603005A	250	0	0
Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electronics Architecture and Standards 15	Ground vehicle electronics architecture and standards advanced development	Reduce Demand	Science and Technology	2040	03	0603005A	1,926	1,342	9,551
Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electronics Architecture and Standards 15I	Ground vehicle electronics architecture and standards advanced development	Reduce Demand	Science and Technology	2040	03	0603005A	1,714	810	5,192
Army	Combat Vehicle and Automotive Advanced Technology	Alternative Energy Research-TARDEC 107T	Ground Vehicle advanced technology development for power generation	Reduce Demand	Science and Technology	2040	03	0603005A	20,000	0	0
Army	Combating Terrorism, Technology Development	AVPTA AVP	Conducts Ground Vehicle Power Technology efforts with DOE	Reduce Demand	Science and Technology	2040	03	0603125A	5,076	5,162	26,628
Army	Combating Terrorism, Technology Development	Powertrain/Energy Storage/Survivability Technology STO DRLV	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603125A	1,412	831	4,403
Army	Combating Terrorism, Technology Development	Powertrain/Energy Storage/Survivability Technology DRLZ	This project matures and demonstrates advanced mobility and electric technologies for advanced propulsion, power, and electrical components and subsystems to enable lightweight, agile, deployable, fuel efficient, and survivable ground vehicles.	Reduce Demand	Science and Technology	2040	03	0603125A	1,588	2,169	14,169
								TOTAL ARMY OE	721,457	946,509	6,327,533

**Table 9. Marine Corps FY 2015 Operational Energy Initiatives
(Dollars in Thousands)**

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Marine Corps	Advanced Power Sources	SPACES, GREENS, RPAs	Advanced Power Sources is a family of small power devices to provide portable electric power for legacy and future weapons, optics, sensors, medical, intelligence and communications systems. The Family consists of multiple suites, to include: Family of USMC Standard Power Supplies, Family of Radio Power Adaptors, Battery Management and Sustainment Systems, Communications / Electronics batteries, Lead acid batteries Battery Chargers and Analyzers, Solar and Renewable Energy Systems, Mobile Electric Hybrid Power Systems (MEHPS), Emerging requirements that involve standardizations, and Naval Lithium Battery Safety Program management.	Diversify Supply	Current Operations	1106	01	0203761M	8,221	0	1,858
Marine Corps	Advanced Power Sources	SPACES, GREENS, RPAs	Advanced Power Sources is a family of small power devices to provide portable electric power for legacy and future weapons, optics, sensors, medical, intelligence and communications systems. The Family consists of multiple suites, to include: Family of USMC Standard Power Supplies, Family of Radio Power Adaptors, Battery Management and Sustainment Systems, Communications / Electronics batteries, Lead acid batteries Battery Chargers and Analyzers, Solar and Renewable Energy Systems, Mobile Electric Hybrid Power Systems (MEHPS), Emerging requirements that involve standardizations, and Naval Lithium Battery Safety Program management.	Diversify Supply	Current Operations	1109	06	0206211M	2,185	12,311	53,160

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Marine Corps	Advanced Power Sources	SPACES, GREENS, RPAs	Advanced Power Sources is a family of small power devices to provide portable electric power for legacy and future weapons, optics, sensors, medical, Intell/Commo systems. The Family consists of multiple suites, to include: Family of USMC Standard Power Supplies, Family of Radio Power Adaptors, Battery Management and Sustainment Systems, Communication/ Electronic. batteries, Lead acid batteries Battery Chargers and Analyzers, Solar and Renewable Energy Systems, Mobile Electric Hybrid Power Systems (MEHPS), Emerging requirements that involve standardizations, and Naval Lithium Battery Safety Program MGMT.	Diversify Supply	Current Operations	1109	06	0502511M	1,910	2,244	11,131
Marine Corps	Advanced Power Sources	SPACES, GREENS, RPAs	Advanced Power Sources is a family of small power devices to provide portable electric power for legacy and future weapons, optics, sensors, medical, Intell/Commo systems. The Family consists of multiple suites, to include: Family of USMC Standard Power Supplies, Family of Radio Power Adaptors, Battery Management and Sustainment Systems, Communication/ Electronic. batteries, Lead acid batteries Battery Chargers and Analyzers, Solar and Renewable Energy Systems, MEHPS, Emerging requirements that involve standardizations, and Naval Lithium Battery Safety Program MGMT.	Diversify Supply	Current Operations	1106	01	0206624M	146	1	5
Marine Corps	Advanced Power Sources	Next Generation SPACES, GREENS	Advanced Power Sources is a family of small power devices to provide portable electric power for legacy and future weapons, optics, sensors, medical, Intell/Commo systems. The Family consists of multiple suites, to include: Family of USMC Standard Power Supplies, Family of Radio Power Adaptors, Battery Management and Sustainment Systems, Communication/ Electronic. batteries, Lead acid batteries Battery Chargers and Analyzers, Solar and Renewable Energy Systems, MEHPS, Emerging requirements that involve standardizations, and Naval Lithium Battery Safety Program MGMT.	Diversify Supply	Current Operations	1319	07	0206624M	830	846	7,367

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Marine Corps	Advanced Power Sources	SPACES, GREENS, RPAs	Advanced Power Sources is a family of small power devices to provide portable electric power for legacy and future weapons, optics, sensors, medical, intelligence and communications systems. The Family consists of multiple suites, to include: Family of USMC Standard Power Supplies, Family of Radio Power Adaptors, Battery Management and Sustainment Systems, Communications / Electronics batteries, Lead acid batteries Battery Chargers and Analyzers, Solar and Renewable Energy Systems, Mobile Electric Hybrid Power Systems (MEHPS), Emerging requirements that involve standardizations, and Naval Lithium Battery Safety Program management.	Diversify Supply	Current Operations	1106	03	0804771M	89	102	530
Marine Corps	Advanced Technology Demo	Energy Efficient Processors/Sensors, Scalable High-Efficiency Fuel Cells, Water Purification and Desalination, Advanced Vehicle Transmissions and Power plants	Solar Powered Image Exploring Sensor (SPIES): Develop ground sensors capable of running advanced signal processing algorithms on battery power by leveraging advances in massively parallel processors. High Efficiency electrodes for Fuel Cells. Hybrid generator for small units (3kW). Water disinfection using UV-LEDs, Hybrid Adsorption Water Pre-treatment system: Elimination of biofouling on water filter surfaces by using Aluminum Oxide particle deposition, High output Piezoelectrics: High-efficiency piezoelectrics using novel materials for energy scavenging, Thermoacoustic Generator/Heat Pump: High-efficiency energy generation using thermoacoustics, First Response Freshwater Purifier: Energy-efficient desalination, NanoRad Power Pack: Packaging of an Alpha-emitter with a Uranium oxide semiconductor to produce extremely energy-dense storage. Continuously Variable Transmission: Provide a lighter, smaller, and more efficient advanced transmission for Marine Corps amphibious and land platforms in the medium to heavy weight class.	Reduce Demand	Science and Technology	1319	03	0603640M	4,500	7,900	47,922

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Marine Corps	Applied Research	Prec. Fires and MEMS, Energy Eff. Processors/ Sensors, Opportune Lift/ Optimize and Auto Resupply and Material Handl, Energy Scavenging, Water Desal., Fuel Eff.	On-board/Off-board WAAS Data Conditioning and Alerting: Development of a power efficient airborne processor capable of running scene understanding and trackers without reducing operational range. Hybrid Multi-Fuel Power Generator: Waste-to-Energy system for expeditionary forces, JP-8 Fuel Cell: Scalable high-efficiency fuel cell running on JP-8, Vortex Desalination: Novel desalination mechanism that uses a low-pressure vortex to evaporate freshwater from a salinated supply. Reduce fuel consumption of the marine Corps' MTRV fleet by at least 15%.	Reduce Demand	Science and Technology	1319	02	0602131M	1,321	2,650	13,068
Marine Corps	Combat Operations Center (COC)	Combat Operations Center (COC)	The Combat Operations Center provides the necessary infrastructure for a scalable transportable C2 Capability.	Reduce Demand	Legacy Force Upgrade/Improvement	1106	01	0206626M	0	1,500	7,500
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range from 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	07	0206624M	435	204	2,098
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range from 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1109	06	0206315M	633	0	1,711
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range from 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1106	01	0206624M	53	55	314
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range from 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1109	06	0502514M	361	95	7,776
Marine Corps	Expeditionary Energy Office	Experimental Forward Operational Base (ExFOB)	Semi-Annual process to evaluate and deploy technologies to support Marine Corps Expeditionary Energy Strategy goals of increased combat effectiveness and reduced dependence on liquid logistics on the battlefield.	Future Force	OE Analysis and Modeling	1319	07	0206313M	2,671	2,257	11,268

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Marine Corps	Expeditionary Energy Office	Expeditionary Energy Office	USMC Senior Official for Operational Energy, Plans and Programs. Tasked by CMC to Analyze, develop, and direct the Marine Corps' energy strategy in order to optimize expeditionary capabilities across all Warfighting functions.	Future Force	OE Analysis and Modeling	1106	04	0902498M	3,847	3,429	17,611
Marine Corps	Family of Expeditionary Water Systems	Small Unit Water Purifiers	Technology upgrades to increase potable water output while reducing system energy demands in order to provide expeditionary point of production water at mid to small forward operating bases, and while on the move. This will reduce resupply efforts.	Reduce Demand	Current Operations	1109	06	0206315M	589	0	0
Marine Corps	Family of Shelters and Shelter Equipment	Shelters, Shelter Liners, Lighting upgrades	Improved R-values for GP Medium; decrease number of shelters by replacing 10-man Arctic with 15-man Arctic shelter; procure more efficient Space Heater Arctic. Also includes efforts to procure next generation lighting.	Reduce Demand	Current Operations	1106	01	0203761M	2,984	0	0
Marine Corps	Family of Shelters and Shelter Equipment	Shelters, Shelter Liners, Lighting upgrades	R&D for future shelter systems and USMC lighting solution of the future.	Reduce Demand	Current Operations	1319	07	0206623M	250	181	1,097
Marine Corps	Futures Directorate	Hybrid Electric ITV Trailer (HEIT)	Combining proven technologies in a novel way, program seeks to provide an ITV-towable, V-22/CH-53/C130 transportable, Mobile Hybrid Power source that can use multiple fuel types to provide quiet sustained power	Diversify Supply	Science and Technology	1319	03	0603640M	0	470	865
Marine Corps	LAV Modification and Sustainment	Mobility & Obsolescence Program (MOB)	Replace the obsolete Full-Up Power pack with a smaller, more efficient off-the-shelf unit	Reduce Demand	Legacy Force Upgrade/Improvements	1109	06	0206211M	0	0	45,190
Marine Corps	Medium Tactical Vehicle Replacement (MTVR)	Fuel Efficient MTVR FNC Transition	Through analysis, modeling and simulation, hardware development, integration, test, and evaluation, the Fuel Efficient Medium Tactical Vehicle Replacement (MTVR) FNC program will select, bench test, and integrate a suite of affordable fuel efficiency enabler.	Reduce Demand	Legacy Force Upgrade/Improvements	1106	01	0702808M	0	1,998	5,139
Marine Corps	Medium Tactical Vehicle Replacement (MTVR)	Fuel Efficient MTVR FNC Transition	Through analysis, modeling and simulation, hardware development, integration, test, and evaluation, the Fuel Efficient Medium Tactical Vehicle Replacement (MTVR) FNC program will select, bench test, and integrate a suite of affordable fuel efficiency enabler.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	07	0206624M	479	2,892	5,090

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Marine Corps	Medium Tactical Vehicle Replacement (MTVR)	Fuel Efficient MTRV FNC Transition	Through analysis, modeling and simulation, hardware development, integration, test, and evaluation, the Fuel Efficient Medium Tactical Vehicle Replacement (MTVR) FNC program will select, bench test, and integrate a suite of affordable fuel efficiency enablers.	Reduce Demand	Legacy Force Upgrade/Improvements	1109	05	0206315M	469	1,212	23,855
Marine Corps	Mobile Power Equipment	Advance Mobile Medium Power Sources	The Family of Mobile Power Equipment is a family-of-systems to continuously procure, update, and replenish approximately 19,000 items of Mobile Tactical Power Generation & Distribution Equipment to include the AMMPS system, and 22 different TAMCNs. The Family of Mobile Electric Power Equipment consists of skid & trailer mounted tactical generators ranging from 2 to 200 kilowatts, Mobile Electric Power Distribution Systems, Floodlight Sets, Load Banks & Electrician's Tool Kits. This equipment is procured & fielded to provide electricity on the battlefield. Combat, combat support & combat service support units all require tactical power to operate weapons systems, C4I systems, medical & messing facilities, environmental control equipment, & water purification systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1109	06	0206315M	4,890	745	27,300
Marine Corps	Mobile Power Equipment	Advance Mobile Medium Power Sources	The Family of Mobile Power Equipment is a family-of-systems to continuously procure, update, and replenish approximately 19,000 items of Mobile Tactical Power Generation & Distribution Equipment to include the AMMPS system, and 22 different TAMCNs. The Family of Mobile Electric Power Equipment consists of skid & trailer mounted tactical generators ranging from 2 to 200 kilowatts, Mobile Electric Power Distribution Systems, Floodlight Sets, Load Banks & Electrician's Tool Kits. This equipment is procured & fielded to provide electricity on the battlefield. Combat, combat support & combat service support units all require tactical power to operate weapons systems, C4I systems, medical & messing facilities, environmental control equipment, & water purification systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1106	01	0206624M	101	101	518

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Marine Corps	Mobile Power Equipment	Advance Mobile Medium Power Sources	The Family of Mobile Power Equipment is a family-of-systems to continuously procure, update, and replenish approximately 19,000 items of Mobile Tactical Power Generation & Distribution Equipment to include 22 different TAMCNs. The Family of Mobile Electric Power Equipment consists of skid & trailer mounted tactical generators ranging from 2 to 200 kilowatts, Mobile Electric Power Distribution Systems, Floodlight Sets, Load Banks & Electrician's Tool Kits. This equipment is procured & fielded to provide electricity on the battlefield. Combat, combat support & combat service support units all require tactical power to operate weapons systems, C4I systems, medical & messing facilities, environmental control equipment, & water purification systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	07	0206624M	1,000	500	500
								TOTAL MARINE OE	37,964	41,693	292,873

**Table 10. Navy FY 2015 Operational Energy Initiatives
(Dollars in Thousands)**

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	National Defense Sealift Fund	Future Initiatives	This item represents funding that is set aside to implement initiatives that are currently unidentified but will be developed from the Broad Agency Announcement and Energy Initiative Studies and Development.	Reduce Demand	Legacy Force Upgrade/Improvements	4557 N	02	0408042N	0	0	8,211
Navy	National Defense Sealift Fund	HVAC&R Efficiency Improvement	Implementation of automating plant control systems, matching plant generation to demand, and using Variable Air Volume design; HVAC&R plants can be made efficient through a range of conditions and still retain the full maximum capacity. Examples of initiatives include T-AKE Intelligent HVAC, Endocube and the implementation of intelligent HVAC on other ship classes. Combined with same "HVAC&R Efficiency Improvement" BA Code 04, projected to save approximately 376,000 barrels of fuel from FY10-FY20.	Reduce Demand	Legacy Force Upgrade/Improvements	4557 N	02	0408042N	6,278	3,635	14,207
Navy	Hull, Mechanical & Electrical Support	Shipboard Incentivized Energy Conservation Program	The Shipboard Incentivized Energy Conservation Program (i-ENCON) provides ships with operational techniques to reduce fuel consumption. Naval Sea Systems Command provides ships with the necessary training, tools and guidance that help to increase ships' underway operating hours for improved fleet readiness.	Reduce Demand	Current Operations	1804	04	0708017N	0	578	2,989
Navy	National Defense Sealift Fund	Improved Metering and Monitoring	Installation of fuel and shore power meters. This fuel metering technology corrects for density, technology, and air entrainment, measuring flow to an accuracy of around 0.01% error. A Shore Power Monitor stores energy and power quality data including cumulative kWh, peaks, and several power quality metrics. The compiled data enables MSC to monitor and manage shore power usage and implement appropriate energy conservation measures. The combination of these meters feeds into an Energy Dashboard that monitors energy usage, enabling ship operators to make operational changes that decrease overall energy usage.	Reduce Demand	Measuring, Monitoring, and Data Collection	4557 N	02	0408042N	2,683	2,665	3,151

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	National Defense Sealift Fund	Lighting Upgrades	Upgrade currently installed lighting with newer technologies to increase energy efficiency. Initiatives include using T8 fluorescent bulbs, Light Emitting Diode (LED) technology, installing light switches and intelligent lighting technology such as motion and occupancy sensors. Projected to save approx. 170,000 barrels of fuel FY10-FY20.	Reduce Demand	Legacy Force Upgrade/Improvements	4557N	02	0408042N	704	216	2,386
Navy	Advance Surface Machinery Sys	Advanced Power Generation Module & Non Energy Related Efforts incorrectly tagged in PBIS	Advanced gas turbine to provide better fuel efficiency, meet requirements for advanced sensors and future weapons, reduce weight, and lower life cycle costs. Potentially, DDG-51 Flight III ships could be forward fit with three GTG rather than four. Supported initiatives include evaluating other opportunities for Gas Turbine Efficiency Upgrades. This Initiative also includes Non-Energy related efforts that are currently tagged erroneously as Energy in PBIS.	Reduce Demand	Future Force Development	1319	04	0603573N	3,900	4,500	22,650
Navy	Energy conservation	Auxiliary Systems	Project to identify, test and evaluate new technologies for shipboard auxiliary systems aimed at reducing fuel consumption.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	1,134	0	0
Navy	Surface Combatant Maintenance & Modernization	Bow Bulb Optimization	Bow bulb optimization modifies the shape of the bow bulb by adding an appendage above the sonar dome on DDG class ships. This appendage reduces hull wave drag without increasing hull resistance, impinging on sonar operations or reducing maneuverability.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0204228N	0	1,401	14,701
Navy	Amphib Maintenance & Modernization	Directional Stability	Install two medium fixed fins will improve directional stability and could reduce power up to 13%, increase fuel efficiency by 3%.	Reduce Demand	Legacy Force Upgrade/Improvements	1804	01	0204411N	1,100	1,100	1,100
Navy	Energy Conservation	Electrical Systems	This project will be utilized to identify and perform land based and shipboard testing of ship electrical system improvements to reduce energy consumption.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	2,201	0	8,191
Navy	National Defense Sealift Fund	Policy Guidance & Development and Training & Incentive Program	Implementing class-wide or fleet-wide policy that can result in more efficient ship operation. Integrating energy efficiency training into existing Civilian Mariner Engineering Officer (CMEO) Training program. Implementing an incentive program to incentivize efficient ship operation and the generation of energy conservation initiatives. Combined with same "Policy Guidance & Development and Training & Incentive Program" BA Code 04, projected to save approximately 10,000 barrels of fuel from FY10-FY20.	Future Force	Doctrine, Training, Education	4557N	02	0408042N	26	27	138

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	National Defense Sealift Fund	Pump & Motor Efficiency Improvements	Implement variable speed technology to increase the efficiency of existing pumps and motors to better match actual demand. Also installing newer, more efficient pump and motor options. Combined with same "Pump & Motor Efficiency Improvements" BA Code 04, projected to save approximately 126,000 barrels of fuel FY10-FY20.	Reduce Demand	Legacy Force Upgrade/Improvements	4557 N	02	0408042N	1,214	1,088	4,742
Navy	Energy Conservation	Energy Monitoring & Assessment	Methods of capturing/ displaying energy related data to shipboard personnel as actionable information for ships to employ energy conservation measures underway and in port as mission requirements permit.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	6,439	6,039	13,156
Navy	Advance Surface Machinery Sys	Energy Storage & Non Energy Related Efforts incorrectly tagged in PBIS	ESO responsible for developing Next Generation Integrated Power System (NGIPS) technology aboard Navy Ships to provide smaller, simpler, more affordable, and more capable power systems. Supported initiatives include Energy Storage for Stable Backup Power (SBP). This Initiative also includes Non-Energy related efforts that are currently tagged erroneously as Energy in PBIS.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603573N	5,000	5,100	18,100
Navy	National Defense Sealift Fund	Route Planning & Optimization	Implementing route planning programs, such as the Replenishment At Sea Planner (RASP), can improve MSC's scheduling of ships between ports and underway combatant customer ships, thereby reducing fuel consumption. Once underway, ship optimization tools can be used to optimize the ship's equipment to further reduce fuel consumption. Combined with same "Route Planning & Optimization" BA Code 04, projected to save approximately 297,000 barrels of fuel from FY10-FY20.	Reduce Demand	Current Operations	4557 N	02	0408042N	532	706	4,041
Navy	National Defense Sealift Fund	Auditing, Modeling & Savings Analysis	Operational Logistics (OPLOG) R&D with Military Sealift Command (MSC) manages and conducts energy audits analyzing energy usage onboard ships, facilitate and optimize energy reduction methods, and analyze the alternatives to reduce energy costs. Data feeds the ENCON Calibrated Baseline Model for each ship class. Audit input data calibrated, the model is an accurate and flexible tool to generate baseline energy usage profiles for various missions, load-outs, area or operations, and operating conditions. Projected to save approx. 18,000 barrels of fuel FY10-20.	Future Force	OE Analysis and Modeling	4557 N	04	0408042N	1,567	1,542	6,981

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Energy Conservation	Hull Husbandry	This project will be utilized to identify and evaluate new underwater hull coating systems and underwater hull cleaning and maintenance techniques to reduce hydrodynamic drag on the hull and thereby increase fuel efficiency.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	300	0	700
Navy	Energy Conservation	Hull Hydrodynamics	This project area will accomplish development, modeling, laboratory and Fleet testing of ship modifications to propellers such as fouling release coatings and/or hull appendages to determine overall mission and cost effectiveness of these improvements.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	1,357	879	4,879
Navy	Energy Conservation	HVAC	This project will be utilized to accomplish prototype development, land and shipboard testing to determine cost effectiveness of improvements aimed at more efficient climate control of shipboard spaces.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	2,675	2,360	2,850
Navy	National Defense Sealift Fund	Energy Conservation Broad Agency Announcement	Naval Surface Warfare Center Carderock Division's (NSWCCD) Energy Conservation (ENCON) Broad Agency Announcement (BAA) is intended to solicit industry, academia, and Government agencies to discover new, cost-effective, and innovative ways of using energy through new equipment or technology. Projected to save approximately 94,000 barrels of fuel from FY10-FY20.	Reduce Demand	Legacy Force Upgrade/Improvements	4557N	04	0408042N	1,700	2,775	16,441
Navy	National Defense Sealift Fund	Energy INIT Studies and Development	Research, identify, and develop energy saving initiatives to the point where they can be directly applied to ship-based environments.	Reduce Demand	Legacy Force Upgrade/Improvements	4557N	04	0408042N	1,019	1,727	11,348
Navy	Ship Contract Design/Live Fire T&E	Hybrid Electric Drive Implementation	Complete Machinery Software System (MCS) integration development. Completion of Factory Acceptance Test (FAT), environmental qualification testing (EQT) and performance testing in Land Based Engineering Site (LBES). Complete Integrated Logistics Support (ILS) certifications and ship design development. Commencement, completion, delivery and installation of Low Rate Initial Production (LRIP) units to achieve fuel efficiency and increase on-station time.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	05	0604567N	7,949	4,222	11,149
Navy	Hybrid Electric Drive (HED)	Hybrid Electric Drive Implementation	Funds HED shipsets to include the propulsion motors, motor drives and the associated controls, interfaces, and mounting equipment that will be required to install the HED on DDG 51 Class Ships. This budget supports HED installation on DDG 51 Class in-service ships (backfit) beginning in FY16.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0708017N	12,638	32,906	200,485

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Amphibious Tactical Supt Units	LCAC Efficiency Improvements	In conjunction with the LCAC Service Life Extension Program (SLEP), multiple upgrades are being investigated for the platform, including torque meters and active shaft balancing. Successful initi. Will be installed as the units are upgraded through SLEP.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	07	0204413N	31	0	0
Navy	National Defense Sealift Fund	Hull Coatings	Testing/ prototyping apply commercial available hull coatings to better match hull coating to ship OPTEMPO. Goal: prevent biofouling so propulsive efficiency is MAX.	Reduce Demand	Legacy Force Upgrade/Improvements	4557N	04	0408042N	1,789	150	351
Navy	Surface Combatant Maintenance & Modernization	LM2500 Efficiency Implementation	The LM2500 R&D Program will modify the engine controller; reduce leak paths in the LM2500 compressor; reduce flow losses in the air intake and exhaust ducts; improve hot section; improve depot repair standards; investigate energy recovery strategies and automate gas turbine on-line water wash.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0204228N	0	0	4,825
Navy	Energy Conservation	Maritime Energy EFF R&D	This supports overall FRRDP execution and currently unidentified projects in the out-years of the FYDP.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	0	0	40,098
Navy	Energy Conservation	Power Generation and Storage	Project area will accomplish development, laboratory and Fleet testing to determine overall mission and cost effectiveness of improved power generation and storage Tech.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	1,229	0	635
Navy	Amphib Maintenance & Modernization	Propeller Coatings	An easy-release propeller coating system allows amphibs. with long pier-side periods to shed propeller bio-fouling once underway. This TECH is currently achieving fuel savings for MSC ships and commercial shipping.	Reduce Demand	Legacy Force Upgrade/Improvements	1804	01	0204411N	0	160	160
Navy	Energy Conservation	Propulsion Systems	This project will be used to ID Reqts and perform land based and shipboard testing of ship propulsion system improvements on Gas Turbine, Steam, and Diesel Engine systems reducing fuel consumption and lower MAINT.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	885	0	8,252
Navy	National Defense Sealift Fund	HVAC&R Efficiency Improvement	Design/ research ways of automating plant control systems, matching plant generation to demand, and using Variable Air Volume design; HVAC&R plants can be made efficient through a range of conditions and still retain the full maximum capacity. Examples of HVAC&R initiatives include T-AKE Intelligent HVAC, Endocube and the implementation of intelligent HVAC on other ship classes. Combined with same "HVAC&R Efficiency Improvement" BA Code 02, projected to save approximately 376,000 barrels of fuel from FY10-FY20.	Reduce Demand	Legacy Force Upgrade/Improvements	4557N	04	0408042N	627	771	3,710

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Surface Combatant Maint. & Modernization	Solid State Lighting	Replacement of existing incandescent lighting fixtures on surface combatants with LED lights that will increase efficiency and operate for a much longer service life.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0204228N	6,035	2,920	18,052
Navy	Amphib Maintenance & Modernization	Solid State Lighting	Replacement of existing incandescent lighting fixtures on amphibious ships with LED lights that will increase efficiency and operate for a much longer service life.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0204411N	3,401	3,767	3,767
Navy	Amphib Maintenance & Modernization	Stern Flaps (Amphibs)	Develop and install stern flaps on LHD 1 and LSD 41/49 class ships. A stern flap was previously modeled and designed for LHD 8 and is directly applicable to LHD 1 class ships. LSD 41/49 would utilize same basic design as LHD 1.	Reduce Demand	Legacy Force Upgrade/Improvements	1804	01	0204411N	800	0	0
Navy	ENERGY CONSERVATION	Thermal Management	This project will be utilized to identify and evaluate potential uses for Thermal Management techniques designed to reduce overall shipboard heat generation and reduce the shipboard electrical demand on HVAC systems.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	100	0	2,993
Navy	Surface Combatant Maintenance & Modernization	Thermal Management Control System (TMCS)	Utilizing a centralized control system, which gathers information compartment by compartment and provides the appropriate conditioning for the compartment, the TMCS could determine the required number and location of AC plants best able to cool the area.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0204228N	8,510	11,656	39,827
Navy	Surface Combatant Maintenance & Modernization	Triton Fuel Penalty Tool	This initiative will develop, install and optimize a system capable of reporting in real time when a ship's powering condition has degraded due to increased drag from biofouling. The system will provide data to the Energy Dashboard to report the fuel penalty produced by hull and propeller fouling, at a confidence level of 95%. Understanding fouling condition influences cleaning frequency and increase efficiency.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0204228N	0	0	4,880
Navy	Amphib Maintenance & Modernization	Variable Speed Drive (VSD) Port Use Fan (PUF)	Modernization of the operation of the PUF provides ships a reliable alternative to operating the FDBs while in-port steaming. This modification will facilitate the use of the PUF with a variable speed drive (VSD) to throttle the speed of the PUF as needed to provide proper combustion air while keeping the PUF vanes wide open. This modification will greatly improve efficiency and reduce fuel consumption while steaming in port.	Reduce Demand	Legacy Force Upgrade/Improvements	1804	01	0204411N	0	640	640

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Surface Combatant Maintenance & Modernization	(VSD) Collective Protection System (CPS)	This system uses an efficient variable speed drive in the CPS to reduce energy consumption by allowing the system to operate in states other than fully on or off.	Reduce Demand	Legacy Force Upgrade/Improvements	1810	01	0204228N	0	4,417	19,807
Navy	National Defense Sealift Fund	Improved Metering and Monitoring	Work packages for fuel meters and shore power meters. This technology corrects for density, technology, and air entrainment and can thereby measure flow to an accuracy of around 0.01% error. A Shore Power Monitor stores energy and power quality data including cumulative kWh, peaks, and power quality metrics. Data enables MSC to monitor/manage shore power usage implements energy conservation measures. The COMBO of meters feeds the Energy Dashboard, monitors real time energy use, enables operators to make OPNL changes to decrease energy use.	Reduce Demand	Measuring, Monitoring, and Data Collection	4557 N	04	0408042N	313	308	1,044
Navy	National Defense Sealift Fund	Policy Guidance & Development and Training & Incentive Program	Develop class or fleet-wide policy resulting in more efficient ship operation. Integrating energy efficiency training into existing Civilian Mariner Engineering Officer (CMEO) Training program. Develop an incentive program to incentivize efficient ship operation and the generation of energy conservation initiatives. Combined with "Policy Guidance & Development and Training & Incentive Program" BA Code 02, projected to save approx. 10,000 barrels of fuel FY10-FY20.	Future Force	Doctrine, Training, Education	4557 N	04	0408042N	549	540	2,598
Navy	Surface Combatant Maintenance & Modernization	Shipboard Energy Dashboard	Energy Dashboard uses the Integrated Condition Assessment System (ICAS) to collect data from shipboard equipment. It includes the Fuel Management System (FMS), which assists pre-underway planning by recommending efficient equipment lineups. Energy Dashboard calculates and instantly displays daily energy consumption rates.	Reduce Demand	Measuring, Monitoring, and Data Collection	1810	01	0204228N	700	612	5,496
Navy	National Defense Sealift Fund	Route Planning & Optimization	Develop route planning programs, such as the Replenishment At Sea Planner (RASP), improving MSC's scheduling of ships between ports and underway combatant customer ships, thereby reducing fuel consumption. Once underway, ship optimization tools can be used to optimize the ship's equipment to further reduce fuel consumption. Combined with "Route Planning & Optimization" BA Code 02, projected to save approx. 297,000 barrels of fuel from FY10-20.	Reduce Demand	Current Operations	4557 N	04	0408042N	448	441	2,121

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Aircraft Energy Conservation	Air ENCON	Develop, implement and sustain Aircraft Energy Conservation Program Office to identify, validate, disseminate and incentivize energy conservation best practices within the Naval Aviation community. Targets include culture, fueling, mission planning, and maint.	Reduce Demand	Current Operations	1319	04	0603724N	1,084	1,242	6,156
Navy	Aircraft Energy Conservation	F/A-18 Magic Carpet	Augmented-pilot flight control mode for integration into F/A-18E/F and EA-18G Reduce pilot workload and simplify the carrier landing task via advanced flight controls and enhanced pilot cueing. Increase pilot performance and pilot/ship safety, reduce requirement for Field Carrier Landing Practice between 25%-50. Potential fuel savings: 1-2 M gallons / year. N98 funding avail. FY16+.	Reduce Demand	Future Force Development	1319	04	0603724N	0	17,200	35,100
Navy	Aircraft Energy Conservation	F-35 Advanced Flight Management System	F-35 program seeks to validate 10-25% potential fuel savings through advanced flight management system capabilities: 1.) Mission Segment Fuel Savings (Optimum Launch & Recovery Profiles, Continuous Decent Approach, Cruise-Climb, Optimized Holding Pattern, etc.) 2.) Total Mission Fuel Minimization (In-flight Trajectory Optimization, Required Navigation Performance) 3.) Reclamation of Airspace Inefficiencies	Reduce Demand	Future Force Development	1319	04	0603724N	0	0	15,631
Navy	Aircraft Energy Conservation	F-35 Trim-Optimizing Flight Control	F-35 program seeks to leverage F/A-18 Trim-Optimizing Flight Control investments to achieve a 1.8% reduction in surface control drag (15 nm mission radius improvement).	Reduce Demand	Future Force Development	1319	04	0603724N	616	0	13,574
Navy	Aircraft Energy Conservation	F-35 'Smart Start' Energy Conservation Mode	Optimize fuel efficiency of F-35 by increasing amount of preflight checks performed using the power Thermal Management System (PTMS) vice the main engine. Testing will ensure that there are no adverse impacts to any of the aircraft subsystems. These tech. will be forward fit in F-35 Block 4B (2022) and later.	Reduce Demand	Future Force Development	1319	04	0603724N	2,161	2,566	13,619
Navy	Aircraft Energy Conservation	F-35 Engine Efficiency	This initiative will optimize the fuel efficiency of the F-35 engine with various technologies, including Advanced Compressor Technology, Optimized Turbine Cooling, Advanced Turbine Clearance Control, and Fuel Burn Optimized Control Mode. These technologies will be forward fit in F-35 Block 4B (2022) and beyond with the potential to be retrofit into existing systems during planned depot maintenance.	Reduce Demand	Future Force Development	1319	04	0603724N	25,625	18,143	22,138

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Aircraft Energy Conservation	New Opportunity Studies	The aircraft energy conservation RD TEN project IDs, evaluates, validates and advocates for implementation of energy savings initiatives for legacy aircraft by engaging technical experts from across Naval aviation, other services, allies industry, and academia.	Reduce Demand	Future Force Development	1319	04	0603724N	0	0	48,730
Navy	Aircraft Energy Conservation	F/A-18 Trim-Optimizing Flight Control	By optimizing aircraft trim configuration across a variety of flight conditions, a control algorithm developed by NASA Dryden was able to reduce F/A-18A fuel consumption by 3.5% across three test flights without negatively impacting transient performance. Technology transition efforts are focused on the F/A-18 E/F and E/A-18 G.	Reduce Demand	Legacy Force Upgrade/Improvements	1319	04	0603724N	550	2,004	7,158
Navy	Common Group Equipment	Simulator Upgrades	The Navy Aviation Simulator Master Plan (NASMP) identified capability (fidelity) and capacity upgrades required to maximize T&R simulation for F/A-18E/F, EA-18G, and MH-60R/S aircraft given fiscal, technological, and minimum flight time limitations.	Reduce Demand	Current Operations	1506	07	0804743N	72,925	79,303	400,511
Navy	Mobility Fuels	Alternative Fuels Test and Qualification Program	This program develops technical data through the execution of laboratory, component, engine, fuel system, and weapon system tests, which evaluates the effects of changes in fuel chemistry and properties on the performance and reliability of Naval ship, aircraft, and fuel distribution systems.	Diversify Supply	Engine Test and Certification	1319	04	0603724N	10,745	12,509	62,629
Navy	Defense Research Sciences	YIP - Low-dimensional Semiconductor Nanostructures for Organic Photovoltaics	Explore the use of one dimensional organic crystals to improve the performance of organic bulk heterojunction photovoltaics.	Reduce Demand	Science and Technology	1319	01	0601153N	47	0	0
Navy	Defense Research Sciences	YIP - Advanced Nanoengineered Thermal Management Devices	Investigations of novel nanoengineered surfaces to understand fluidic and thermal transport processes during phase-change heat transfer. Experiments and modeling will be used to determine how various parameters of the nanostructured features affect the coupled heat and mass transport processes.	Reduce Demand	Science and Technology	1319	01	0601153N	78	0	0
Navy	Defense Research Sciences	YIP - Ignition and Oxidation of Bio-derived Future Navy Fuels	Investigation of the ignition and oxidation chemistry for next-generation bio-derived Navy fuel blends in a novel rapid compression machine specifically designed for testing of heavy oxygenated fuels with low vapor pressure.	Diversify Supply	Science and Technology	1319	01	0601153N	112	0	0

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Defense Research Sciences	Synthetic Biology for Sensing & Energy Production	Studies microbial physiology mechanisms that mediate electrosynthesis (use of electrical current as an electron donor for metabolic processes) and novel bioengineering tools and strategies for enabling microbes to detect and produce physical and/or chemical signals.	Diversify Supply	Science and Technology	1319	01	0601153N	300	300	1,500
Navy	Defense Research Sciences	Microbial and Biomolecular Fuel Cell	Elucidate/optimize marine microbes and mechanisms responsible for electron transfer to anodes (in sediments) and cathodes (in overlying water) and configure electronics to allow practical powering of low-power devices.	Diversify Supply	Science and Technology	1319	01	0601153N	700	500	500
Navy	Defense Research Sciences	Naval Future Fuels	Accelerate the adoption of biofuels and blended logistic fuels by supporting Navy certification process, and understand and mitigate the impact of emerging fuels on naval power systems and operations.	Diversify Supply	Science and Technology	1319	01	0601153N	756	769	4,017
Navy	Defense Research Sciences	Power and Energy Materials Research - Chemical Dynamics	Conduct fundamental research to identify and investigate suitable materials for energy storage (e.g. advanced polymer, composite dielectric film, multi-layer glass-ceramic composite).	Diversify Supply	Science and Technology	1319	01	0601153N	1,199	1,234	6,488
Navy	Defense Research Sciences	Heat Transfer & Thermal Management Science	Fundamental studies and physics-based models of evaporative cooling, including heat transfer and critical heat flux.	Reduce Demand	Science and Technology	1319	01	0601153N	1,710	1,636	9,123
Navy	Defense Research Sciences	Power and Energy Materials Research - Electrochemical Materials S&T	Conduct fundamental research to identify and investigate suitable materials for energy storage (e.g. advanced polymer, composite dielectric film, multi-layer glass-ceramic composite).	Diversify Supply	Science and Technology	1319	01	0601153N	1,952	2,010	10,566
Navy	Defense Research Sciences	Ship Hydrodynamics	Provide design tools for high performance, efficient, low signature hull forms and propulsors and optimize integration of the hull-propulsor as a system.	Reduce Demand	Science and Technology	1319	01	0601153N	2,000	2,100	10,500
Navy	Defense Research Sciences	Propulsion Basic Research	The Propulsion focus area of the Sea-Based Aviation National Naval Responsibility will provide innovative research and technology in propulsion, power and thermal management-related fields including Energy-Efficient Processes and Subsystems for future Naval Aviation needs	Reduce Demand	Science and Technology	1319	01	0601153N	2,100	2,130	9,501

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Defense Research Sciences	Power and Energy Mat. Research - Functional Polymeric Materials	Conduct fundamental research to identify and investigate suitable materials for energy storage (e.g. advanced polymer, composite dielectric film, multi-layer glass-ceramic composite).	Diversify Supply	Science and Technology	1319	01	0601153N	2,166	2,230	11,724
Navy	Defense Research Sciences	Distribution/Control of Power Science	Explore design concepts for advanced power distribution, including multifunctional power controllers, electronic decoupling concepts, adaptive/ reconfigurable power tech. and high power switching/ pulse forming networks.	Reduce Demand	Science and Technology	1319	01	0601153N	2,234	2,325	12,096
Navy	Defense Research Sciences	Energy Storage and Power Management	Understand fundamental chemistry, physics and the effects of scale. Develop novel materials and architectures for energy storage and novel materials to enable energy transformation processes. Synthesis of novel polymer and composite dielectric materials and optimization of discharge rates.	Reduce Demand	Science and Technology	1319	01	0601153N	2,279	2,373	12,348
Navy	Force Protection Applied Research	Energy Efficiency & Alt. Energy Tech - Energy Efficiency & Maint Synergy	Develop and demonstrate novel power generation, energy storage and efficiency technologies	Reduce Demand	Science and Technology	1319	02	0602123N	500	500	2,500
Navy	Force Protection Applied Research	Next Generation Integrated Power System	Explore design concepts for advanced power distribution, including multifunctional power controllers, electronic decoupling concepts, adaptive and reconfigurable power technology, and high power switching and pulse forming networks.	Reduce Demand	Science and Technology	1319	02	0602123N	926	933	4,618
Navy	Force Protection Applied Research	Energy Efficiency & Alternative Energy Techs/ Photovoltaics	Improve the photovoltaic device and system efficiency for lightweight, low-cost Photovoltaic (PV) power systems	Reduce Demand	Science and Technology	1319	02	0602123N	1,000	1,000	5,000
Navy	Force Protection Applied Research	Energy Efficiency & Alternative Energy Tech - Unmanned Systems	Develop and demonstrate hydrogen powered fuel cells for small Unmanned Aerial Vehicles (UAVs) to address size, performance and endurance	Diversify Supply	Science and Technology	1319	02	0602123N	1,000	1,000	5,000
Navy	Force Protection Applied Research	Energy Efficiency & Alternative Energy Tech - Biofuels	Determine the viability of alternative fuels derived from biomass and waste sources for naval gas turbine and diesel engine operations.	Diversify Supply	Science and Technology	1319	02	0602123N	2,000	2,000	10,000

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Force Protection Applied Research	Ship Hydrodynamics	Provide design tools for high performance, efficient, low signature hull forms and propulsors and optimize integration of the hull-propulsor as a system.	Reduce Demand	Science and Technology	1319	02	0602123N	2,303	2,064	11,408
Navy	Force Protection Applied Research	Naval Future Fuels	Accelerate the adoption of biofuels and blended logistic fuels by supporting Navy certification process, and understand and mitigate the impact of emerging fuels on naval power systems and operations.	Diversify Supply	Science and Technology	1319	02	0602123N	2,500	2,500	12,500
Navy	Force Protection Applied Research	Propulsion Applied Research	The Propulsion focus area of the Sea-Based Aviation National Naval Responsibility will provide innovative research and technology in propulsion, power and thermal management-related fields including Energy-Efficient Processes and Subsystems for future Naval Aviation needs	Reduce Demand	Science and Technology	1319	02	0602123N	4,626	4,250	18,611
Navy	Force Protection Applied Research	Advanced UUV Power & Energy	Develop and demonstration novel Unmanned Undersea Vehicle (UUV) power systems to enable long endurance missions.	Reduce Demand	Science and Technology	1319	02	0602123N	5,044	0	0
Navy	Force Protection Applied Research	Naval Variable Cycle Engine Technology	Identify and mature critical, relevant variable/adaptive cycle system technologies for the next generation carrier-based aircraft that combine high performance with fuel efficiency.	Reduce Demand	Science and Technology	1319	02	0602123N	6,698	0	0
Navy	Force Protection Applied Research	Energy Efficiency & Alternative Energy Tech - Sustainability/ Outreach	Investigate, develop and/or evaluate and demonstrate alternative energy and energy efficiency technologies; and support STEM and Veteran/Wounded Warrior energy education pilot program	Reduce Demand	Science and Technology	1319	02	0602123N	7,461	6,859	39,120
Navy	Force Protection Applied Research	Platforms	Sea-Based Aviation NNR applied research efforts in Design, materials selection, fabrication, inspection and maintenance related to air-vehicle structures research	Reduce Demand	Science and Technology	1319	02	0602123N	8,429	8,478	42,983
Navy	Force Protection Applied Research	Electric Ship Research & Development Consortium	A consortium of virtually linked academic institutions with hardware-in-the-loop capability coupled with physics based models for system design, testing, and validation.	Reduce Demand	Science and Technology	1319	02	0602123N	10,494	10,129	53,660
Navy	Warfighter Sustainment Applied Research	Synthetic Biology for Sensing & Energy Production	Studies microbial physiology mechanisms that mediate electrosynthesis (use of electrical current as an electron donor for metabolic processes) and novel bioengineering tools and strategies for enabling microbes to detect and produce physical and/or chemical signals.	Diversify Supply	Science and Technology	1319	02	0602236N	150	150	750

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Warfighter Sustainment Applied Research	Biocentric Technology - Microbial Fuel Cell	Elucidate/optimize marine microbes and mechanisms responsible for electron transfer to anodes (in sediments) and cathodes (in overlying water) and configure electronics to allow powering of low-power devices.	Diversify Supply	Science and Technology	1319	02	0602236N	750	750	2,750
Navy	Undersea Warfare Applied Research	USW Power & Energy	Develop and demonstrate high speed, long endurance undersea weapons	Reduce Demand	Science and Technology	1319	02	0602747N	1,200	1,200	6,000
Navy	Undersea Warfare Applied Research	Long Duration Unmanned Undersea Vehicle	Develop high endurance power and air-independent propulsion for UUVs.	Reduce Demand	Science and Technology	1319	02	0602747N	6,600	4,100	4,100
Navy	Future Naval Capabilities Applied Research	Advanced Material Propeller (FNC)	Develop a pitch-adapting composite submarine propeller with a flexible tip for pitch adaptation, and blade-to-hub joint for modularity and replaceability.	Reduce Demand	Science and Technology	1319	02	0602750N	259	0	0
Navy	Future Naval Capabilities Applied Research	Corrosion Resistant Surface Treatment (FNC)	An integrated system that provides corrosion protection and fouling control, and threat detection.	Reduce Demand	Science and Technology	1319	02	0602750N	558	210	210
Navy	Future Naval Capabilities Applied Research	Renewable Thermal Engine (FNC)	3-5 kW tactical deployable thermal engine capable of utilizing existing and alternative fuels, and concentrated solar thermal energy	Reduce Demand	Science and Technology	1319	02	0602750N	1,164	513	513
Navy	Future Naval Capabilities Applied Research	High Power Solid State Circuit Protection for Power Distribution and Energy Storage (FNC)	Develop and demonstrate high speed, medium voltage direct current circuit breakers for ship power distribution system	Reduce Demand	Science and Technology	1319	02	0602750N	1,860	2,675	5,175
Navy	Future Naval Capabilities Applied Research	Air Independent Propulsion System (FNC)	Develop and demonstrate a long endurance, scalable air independent energy storage solution for undersea vehicles to support long complex multi-mission scenarios	Reduce Demand	Science and Technology	1319	02	0602750N	3,815	712	712
Navy	Force Protection Advanced Technology	Naval Variable Cycle Engine Technology	ID and mature critical, relevant variable/ adaptive cycle system TECH. for the next generation carrier-based aircraft that combine high performance with fuel efficiency.	Reduce Demand	Science and Technology	1319	03	0603123N	6,714	6,139	31,186
Navy	Future Naval Capabilities Advanced Technology Development	Corrosion Resistant Surface Treatment (FNC)	An integrated system that provides corrosion protection and fouling control, and threat detection.	Reduce Demand	Science and Technology	1319	03	0603673N	1,003	841	841

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Future Naval Capabilities Adv. Tech. Develop.	Advanced Material Propeller (FNC)	Develop a pitch-adapting composite submarine propeller with a flexible tip for pitch adaptation, and blade-to-hub joint for modularity and replaceability.	Reduce Demand	Science and Technology	1319	03	0603673N	1,418	200	200
Navy	Future Naval Capabilities Advanced Technology Development	High Power Solid State Circuit Protection for Power Distribution and Energy Storage (FNC)	Develop and demonstrate high speed, medium voltage direct current circuit breakers for ship power distribution system	Reduce Demand	Science and Technology	1319	03	0603673N	2,440	2,125	8,675
Navy	Future Naval Cap. Adv. Tech DEVELOP.	Renewable Thermal Engine (FNC)	3-5 kW tactical deployable thermal engine capable of utilizing existing and alternative fuels, and concentrated solar thermal energy	Reduce Demand	Science and Technology	1319	03	0603673N	2,592	2,054	2,054
Navy	Future Naval Capabilities Advanced Technology Development	Affordable Common Radar Architecture (FNC)	Develop/ demonstrate a common scalable architecture for naval and mobile expeditionary systems. Array developed and System Integration FY12; Final test and demo. FY13; Transition to PEO IWS FY14.	Reduce Demand	Science and Technology	1319	03	0603673N	2,900	0	0
Navy	Future Naval Capabilities Adv. Tech. Develop.	Air Independent Propulsion System (FNC)	Develop and demonstrate a long endurance, scalable air independent energy storage solution for undersea vehicles to support long complex multi-mission scenarios	Reduce Demand	Science and Technology	1319	03	0603673N	6,431	2,849	2,849
Navy	Items less than \$5 Million	Expeditionary Trailer Mounted ECU/Generator (ETMEG)	This initiative is a phased replacement of the existing Generator ECU Trailer (GET), which uses components that are less efficient than current generation technology. The Expeditionary Trailer-Mounted ECU Generator (ETMEG) capability will be a self-contained system consisting of a diesel generator and Collective Protection-approved ECU mounted on an M-Series style single-axle trailer. Leveraging current technology, a 20% reduction of the GET is expected.	Reduce Demand	Current Operations	1810	05	0204455N	99	202	11,367
Navy	Construction & Maint Equip	Advanced Medium Mobile Electric Power Sources (AMMPS)	The current legacy Tactical Quiet Generators are currently being replaced with Advanced Medium Mobile Electric Power Sources (AMMPS). AMMPS is a technologically advanced, third generation family of medium power military generators (5-60 kilowatts (kW)). AMMPS delivers 21 percent better fuel efficiency (average across fleet) and significantly exceeds the reliability of the second generation generator (Tactical Quiet Generator). These are 1 to 1 replacements with the current system.	Reduce Demand	Current Operations	1810	05	0204455N	124	442	2,126

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Items less than \$5 Million	Environmental Control Unit 50 (ECU50)	Develop and field ECU technology to: -decrease fuel required by ECUs by 20% (threshold) to 50 % (objective); -Equipment must be rated for expeditionary operating environments; -Fit within the size/weight envelope of current deployed systems; -No increase in required logistics support and -Procurement cost that is <25%; Higher than current deployed systems	Reduce Demand I	Current Operations	1810	05	0204455N	0	0	9,000
Navy	Items less than \$5 Million	Expeditionary Power Integration and Control (EPIC)	Power generation and distribution at the Navy's expeditionary camps is distributed, redundant and inefficient. These initiative implements technologies developed by the other Services in a configuration and manner that meets the Navy's requirements to integrate, manage, control, and distribute electric power, with energy savings in excess of 50% expected. The solution to be fielded, Expeditionary Power Integration and Control (EPIC), will provide an autonomous capability to intelligently integrate and control multiple generators of varying size through phase balancing, monitoring and metering, load shedding, and load adjustment; provide uninterrupted power while power generation is secured; and accept and control input from optional renewable power generation sub-systems.	Reduce Demand	Current Operations	1810	05	0204455N	0	0	20,340
Navy	Items less than \$5 Million	Improved Environmental Control Unit (IECU)	Replacement of Environmental Control Units (ECUs) with units that incorporate variable speed fan drives and multi-frequency drive components which are ~20% more energy efficient.	Reduce Demand	Current Operations	1810	05	0204455N	55	0	73
Navy	Combat Support Forces	LED Lights	This initiative is to integrate more efficient lighting into newly designed facilities for the NECC Enterprise Tactical Command and Control (NETC2) system. The initiative replaces traditional incandescent bulbs with LED fixtures and leverages RDT&E efforts already undertaken by the Army.	Reduce Demand	Current Operations	1804	01	0204455N	500	500	500

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
Navy	Combat Support Forces	Solar Shades (ULCANS/ARCAS)	Procure and field solar shades for soft-walled shelters used in expeditionary tent camps. In extensive testing performed by the Army and Air Force, shades reduced the solar load on the skin of shelters by up to 80%, improving energy efficiency by 25%. Shades already exist in the expeditionary tent camps; however, they've been primarily employed for camouflage capability vice for energy savings. This initiative increases the density of assets across the TOAs.	Reduce Demand	Current Operations	1804	01	0204455N	2,000	2,000	2,000
Navy	Combat Support Forces	Energy Efficient Liners	This initiative is to outfit existing soft-walled shelters used in expeditionary tent camps with energy efficient liners. The existing, uninsulated shelters drive energy consumption at forward bases where the cost of delivered energy is among the highest on the battlefield. The liners improve the R factor of the shelter, improving the energy efficiency of the shelter by approximately 21% based on extensive testing performed by Army Force Sustainment Systems.	Reduce Demand	Current Operations	1804	01	0204455N	2,000	2,500	5,000
Navy	Facilities Improvement	Environmental Control Unit 50 (ECU50)	This initiative matures high efficiency environmental control unit (ECU) technologies from Technology Readiness Level 6 to TRL 7/8 to support phased replacement of expeditionary ECUs, which are a significant energy consumer at forward bases where the cost of delivered energy is among the highest on the battlefield. To dramatically increase ECU efficiency (50% objective/20% threshold), NAVFAC, OPNAV N45E and DOE's Advanced Research Projects Agency (ARPA-E) jointly developed a proposal to leverage ARPA-E's Program for Building Energy Efficiency Through Innovative Thermodevices. The proposal was funded by OSD OEPP and the project is on track to deliver two promising technologies for transition to this initiative (Sterling cycle and generator waste heat recovery), and a third, less-developed technology (dehumidification) has been identified for further development either by OEPP or ONR.	Reduce Demand	Current Operations	1319	04	0603725N	486	3,497	5,493
								TOTAL Navy OE	315,271	323,794	1,572,775

**Table 11. Defense-Wide FY 2015 Operational Energy Initiatives
(Dollars in Thousands)**

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2015	FY 2016	FYDP
DLA	Innovative Products and Services for DLA Customers	Energy Efficiency & Alternative Energy Technologies - Alternative Fuels	Energy Readiness program (ERP) supports Alternative Energy Development to include test and certification to support the addition of synthetic and alternative fuels to mobility fuel specifications.	Diversify Supply	Alternative Fuels	0400	03	0603712S	1,743	1,774	5,943
DLA	Battery Network (BATTNET)	Energy Efficiency & Alternative Energy Technologies - Alternative Fuels	BATTNET is focused on improving the supply and reducing the cost of procured batteries used in fielded weapon systems, such as communication radios and armored vehicles. Batteries exhibit dynamic challenges for military logistics. BATTNET is a community of practice of battery supply chain members, engineering support activities, researchers, and users. BATTNET conducts R&D to address sustainment gaps and bridge technical solutions into higher MRLs for specific groups of batteries.	Diversify Supply	Batteries	0400	07	0708011S	2,002	2,024	10,506
OSD	Operational Energy Capability Improvement Funding	Operational Energy Capability Improvement Funding (OECIF)	Improves the Department's OE effectiveness via targeted S&T investments.	Reduce Demand	Science and Technology	0400	03	0604055D	31,800	37,420	199,833
OSD	Operational Energy Plans and Programs Office	Operational Energy Plans and Programs Office	OSD Senior Officials for Operational Energy, Plans and Programs. Tasked to Analyze, develop, and direct OE's energy strategy	Reduce Demand	Doctrine, Training, Education	0100	04	0901388D8 Z	5,569	5,569	27,845
								TOTAL Defense Wide OE	41,114	46,787	244,127

Appendix E. Recommended Changes in Organization or Authority

At this time, the Department has no recommendations for changes in organization or authority.

CLEARANCE REQUEST FOR PUBLIC RELEASE OF DEPARTMENT OF DEFENSE INFORMATION

(See Instructions on back.)

(This form is to be used in requesting review and clearance of DoD information proposed for public release in accordance with DoDD 5230.09.)

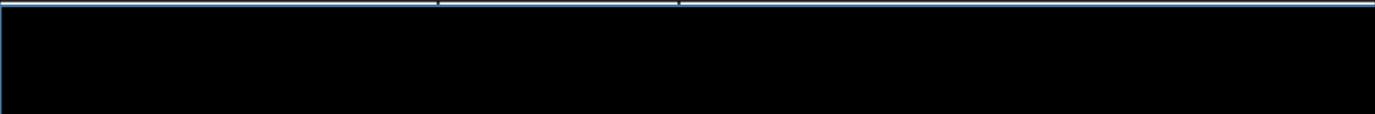
TO: (See Note) Chief, Office of Security Review, 1155 Defense Pentagon, Washington, DC 20301-1155

Note: Regular mail address shown above. For drop-off/next day delivery, use:
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1. DOCUMENT DESCRIPTION

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c. PAGE COUNT 78	d. SUBJECT AREA Annual Report on Operational Energy matters by the Department

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4. POINT OF CONTACT

Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

5. PRIOR COORDINATION

a. NAME (Last, First, Middle Initial)	b. OFFICE/AGENCY	c. TELEPHONE NO. (Include Area Code)
See Attached Coord Sheet (TAB C)		

6. REMARKS

Title 10 U.S.C. 2925(b) directs the Department of Defense to report to Congress on Operational Energy matters for the fiscal year. Tab A is the report, the DUSD(AT&L) signed transmittal letters (TAB B) and the Congressional Management office mailed the reports to President of the Senate, the Speaker of the House, and applicable Congressional committees on 5 July 2017. As in previous years, request to post this report to the Operational Energy web site. http://www.acq.osd.mil/eie/OE/OE_index.html.

7. RECOMMENDATION OF SUBMITTING OFFICE/AGENCY

a. THE ATTACHED MATERIAL HAS DEPARTMENT/OFFICE/AGENCY APPROVAL FOR PUBLIC RELEASE (qualifications, if any, are indicated in Remarks section) AND CLEARANCE FOR OPEN PUBLICATION IS RECOMMENDED UNDER PROVISIONS OF DODD 5230.09. I AM AUTHORIZED TO MAKE THIS RECOMMENDATION FOR RELEASE ON BEHALF OF:

DASD(OE)

b. CLEARANCE IS REQUESTED BY 20170719 (YYYYMMDD).

