

Fiscal Year 2017 Operational Energy Annual Report



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Introduction

This report satisfies the Department of Defense (DoD) Operational Energy Annual Report requirements in section 2925(b) of title 10, United States Code for fiscal year (FY) 2017. The report includes information on operational energy demands, progress in implementing the *2016 Operational Energy Strategy*, investments in alternative fuels, and support to contingency operations.¹ 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.

In FY 2017, the Department consumed over 85 million barrels of fuel to power ships, aircraft, combat vehicles, and contingency bases. This level of energy use has been steady since FY 2013, and reflects relatively consistent operations tempo. To best support our forces and reduce the risks of moving fuel, the Department continues to purchase fuel close to point of use. As such, the Department purchased nearly 55 percent of its fuel outside of the U.S. in FY 2017.

The arrival of a new Administration brought significant changes in leadership and Department priorities. For operational energy, these changes included a new Under Secretary of Defense for Acquisition, Technology and Defense (USD(AT&L)), and a new Assistant Secretary of Defense for Energy, Installations and the Environment (ASD(EI&E)). Together with the recently published *National Defense Strategy*, the Department is placing increased emphasis on ensuring mission accomplishment through resilient forces and facilities.

As part of this transition, the Office of the ASD(EI&E) (OASD(EI&E)) reviewed the existing *Operational Energy Strategy* to ensure alignment of objectives, goals, and targets with leadership priorities. The review confirmed that energy remains a fundamental enabler of military capability, and the ability of the United States to project and sustain the power necessary for defense depends on the assured delivery of this energy. Anti-access and area denial (A2/AD) and cyber threats along with our own needs for increased energy for new systems continue to challenge the assured delivery of fuel to combat forces.

This challenging operating environment will continue to drive the Department to make a sharp and clear push for more energy resilient capabilities and systems that reduce the vulnerability of deployed forces to energy disruption and increase the range, reach, time on station, and performance of combat forces.

¹ The *Operational Energy Strategy* can be found at http://www.acq.osd.mil/eie/Downloads/OE/2016%20OE%20Strategy_WEBd.pdf

Implementing the Operational Energy Strategy

Supporting the Secretary of Defense’s focus on readiness and lethality, the *Operational Energy Strategy’s* purpose is to ensure the consistent delivery of energy to the warfighter. The Strategy contributes to that purpose with defined and measureable targets. Of the 15 targets identified in the strategy, the Department identified four for completion in FY 2017. These targets are associated with identifying and reducing risk, and summarized in **Table 1**.

Table 1: OE Strategy Targets for FY 2017

Objectives	Goals	Targets	Status
Identify and Reduce Risks	Identify and Mitigate Energy Related Risks in Deliberate Planning	Review OE risks in campaign and contingency plans as part of established DoD review cycles	Complete
	Improve Energy Supportability of Concepts and Operations	Assess energy supportability and OE vulnerabilities in all identified OE CONOPs	Complete
		Include OE constraints and limitations analyses in all Title 10 wargames	Complete
	Diversify Energy Supplies to Reduce Risk	Identify opportunities for harvesting energy from the surrounding environment in CCMD operations	Complete

Review OE risks in campaign and contingency plans as part of established DoD review cycles.

Background. Joint Publication 5.0, *Joint Operation Planning*, outlines the process the Joint Staff uses to conduct joint, interagency, and multinational planning activities across the full range of military operations. The process includes regular reviews of existing campaign and contingency plans that identify OE risks. After identification, these risks are reported to Congress and other senior leaders in diverse reports like the Quarterly Readiness Report to Congress, Joint Risk Assessment, Joint Logistics Estimate, and Global Logistic Readiness Dashboard. In addition, Combatant Commands annually develop integrated priority lists to prioritize critical capability gaps which include energy challenges and report them to the joint staff.

Assessment. This target is complete. The Joint Staff, Services and DASD(OE) continue to work on means to mitigate identified OE risks.

Assess energy supportability and OE vulnerabilities of all identified CONOPS.

Background. The rise of Chinese power, instability in Eastern Europe, and the increased range and lethality of weapons systems have increased the size of the A2/AD denial region. In response, each Service is developing new Concepts of Operation (CONOPS) to address implications of operating from numerous small, discrete bases rather than from a few large bases

subject to increased opponents' capabilities.

Assessment. This target is complete. The Services are developing new CONOPS (Air Force Adaptive Basing; Navy Distributed Logistics; Army Multi-Domain Battle; Marine Corps Operating Concept) to address the threat to large, static bases. Each CONOPS considers the logistics and energy implications of operations from numerous small, discrete bases. Results of this analysis will be used to inform Service assessments of energy supportability and OE vulnerabilities.

Include OE constraints and limitations analyses in all Title 10 wargames.

Background. OSD OE subject matter experts, working with the Services, include realistic operational concepts (agile logistics and distributed basing concepts), and constraints (logistics capacity; attrition from adversary attacks) as needed to enhance the rigor of Service wargames findings. Service Title 10 wargames include USMC Expeditionary Warrior, Navy Global, Air Force Global Engagement, and Army Unified Quest.

Assessment. This target is complete. The Department, including the OSD staff, Joint Staff and Services successfully achieved the objective of injecting operational energy considerations in the 2017 wargaming activities and is poised to do so further in 2018. The Marine Corps and the Army conducted title 10 wargames in FY 2017, and logistics - including operational energy concepts were a specific point of interest. Likewise, both the Marine Corps and Army intend to use capable logistics tools to collect data for enhance decision making and more comprehensive postgame analysis. In FY2017, the Air Force and Army also engaged in planning efforts for the 2018 title 10 games, which will include operational energy as a limiting constraint.

Identify opportunities for harvesting energy from the surrounding environment in CCMD operations.

Background. The Department is focused on enhancing mission effectiveness and reducing the risk to warfighters through changes in operational energy generation and use. Multiple Component Commands have developed and tested technologies and practices that “harvest” energy from the surrounding environment, thus decreasing the logistic footprint and increasing the overall combat capability of the deployed force.

Assessment. This target is complete. ASD(EI&E) recognizes that reducing demand for energy of all kinds is an essential component of any energy strategy and encourages the Component Commands to continue to explore technologies that allow harvesting of energy from the surrounding environment. Efforts include waste to energy (DLA) at contingency bases, the use of locally available, non-military specification fuels (Air Force), solar-powered light carts and hybrid power trailers (Army), and diffusion of best practices through OASD(EI&E)-

sponsored Communities of Practice.

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

Background. The FY 2016 Annual Report stated that while DLA Energy concluded that the use of commercial specification fuels and infrastructure would reduce cost and gain access to a broader network of suppliers in CONUS, the full OCONUS study was not yet complete. Therefore, the target was assessed as incomplete.

Assessment. The target is now complete. In FY 2017, DLA Energy completed the OCONUS portion of the analysis. The analysis encompassed three functional segments of the aviation turbine fuel supply chain (Source of Supply, Distribution, and Storage) and assessed risk by major fuel purchase programs supporting the geographic Combatant Commanders. Overall, DLA Energy concluded that increased use of commercial aviation fuel slightly reduced risk in normal and surge operations.

Operational Energy Initiatives in FY 2017

As the Department reoriented toward priorities of the new Administration, the operational energy team maintained a supporting set of initiatives to best provide energy to the warfighter. The Department coordinated Joint Requirement Oversight Council changes through the knowledge management decision support system for multiple acquisition programs and participated in numerous Service and Office of Net Assessment wargames to ensure OE equities were well represented. The Department also conducted a regular series of communities of practice meetings to share best practices and technological breakthroughs with Component Commands and Agencies. Specific achievements for FY 2017 are detailed below.

Office of the Secretary of Defense

Within the Office of the Secretary of Defense, the OASD(EI&E) and DLA Energy led operational energy activities in FY 2017.

In accordance with title 10 U.S.C 2926, ASD(EI&E) reviewed the adequacy of the President's Budget for carrying out the Operational Energy Strategy. The Department performed a review of the FY 2018 President's Budget and concluded the budget was adequate for implementing the strategy. The Department also began review of the FY 2019 President's Budget by issuing Program Objective Memorandum (POM) guidance to the Military Departments, reviewing briefings at the Assistant Secretary and Deputy Assistant Secretary-level on Department investments in operational energy specific briefings, and developing the draft report. The Department will use these POM evaluations to evaluate the final President's Budget

in the spring of 2018.

As the new administration arrived, the Department also reviewed existing policy and doctrine to ensure alignment with emerging lines of effort. This included reviews of various DoD Issuances, including DoD Directive 4180.01, DoD Energy Policy, to update roles and responsibilities. The Department also continued to participate in the Global Posture Executive Council (GPEC) as the DoD oversight body for Global Defense Posture. Finally, the Department adapted multiple Joint Publications to ensure that operational energy risks and opportunities are integral to the planning and execution of military operations. As the fiscal year closed, the Department was preparing for the reorganization of USD(AT&L) into USD(Research and Engineering) and USD(Acquisition and Sustainment), effective in February 2018. This realignment will require a further review of duties and roles among the USD(AT&L) offices.

Policy and Doctrine Actions in FY 2017

- DoDD 5134.01, Under Secretary of Defense for Acquisition, Technology, and Logistics
- DoDD 4180.01, DoD Energy Policy
- DoDI 4120.11, Mobile Electric Power Systems
- DoDM 4140.01, Supply Chain Materiel Management Procedures
- Joint Publication 4-0, Joint Logistics
- Joint Publication 4-01, The Defense Transportation System
- Joint Publication 4-01.6, Joint Logistics Over-the-Shore
- Joint Publication 4-08, Logistics in Support of Multinational Operations

OASD(EI&E) continued to shape the experimentation, analysis, and review of future warfighter capabilities and future force architectures. For instance, staff from ODASD(OE) participated in Service and agency wargames as subject matter experts in operational energy strategies, concepts, modeling, and simulation. ODASD(OE) assisted the Services and agencies in the planning and execution of wargames as well as the subsequent analysis of results impacting Service decision making. ODASD(OE) played key roles in the Army's 2017 Unified Quest wargame, the Marine Corps 2017 Expeditionary Warrior wargame, and the PACOM 2017 Logistics wargame, as well as assisted with planning for the Air Force's 2018 Global Engagement, the Army's 2018 Unified Quest wargame, and DLA's 2018 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 Energy Key Performance Parameter (eKPP) and the Energy Supportability Analysis (ESA).

OSD also continued work on the Joint Lesson Learned Information System (JLLIS), including expansion of the database and training. The database has been expanded to include studies and academic papers on operational energy issues, a tracking mechanism for OECIF projects, and expansion of lessons learned for educational and training issues.

OSD also expanded the JP review process by including the OE staff and related operational energy organizations in the overall process. Efforts were successful in providing a more expansive review and feedback of OE equities in the development of joint doctrine.

Defense Logistics Agency

Within OSD, DLA Energy is a critical partner to OASD(EI&E), and pursued a range of OE improvements.

In response to a 2016 Combat Support Agency Review Team finding regarding a lack of DoD policy for fuel additives, the Assistant Secretary of Defense for Logistics and Materiel Readiness (ASD(L&MR)) tasked DLA to form a work group with the services to examine commercial fuel additization processes that create military specification (MILSPEC) products. This effort identified process gaps and seams to better inform policy decisions. The results provided the DoD with a comprehensive additive policy and CONOPS that illustrates equipment development, utilization, ownership, and training implications for the Department of Defense. The Office of ASD(L&MR) and Office of Joint Staff J4 personnel agreed to align policy and publications with language developed by the work group.

In September 2016, the Defense Operational Energy Board (DOEB) Deputies, and the Office of the Deputy Assistant Secretary of Defense for Operational Energy (ODASD(OE)) tasked DLA Energy to identify and evaluate risk factors associated with the conversion to commercial products (JP8 and additives to Jet A/Jet A1) and infrastructure (storage, pipelines, & distribution) prior to the last tactical mile. DLA Energy performed a Global Risk Assessment by:

- Establishing a formal Work Group (WG) comprised of Subject Matter Experts (SMEs) to perform an internal DLA Energy assessment;
- Dividing the supply chain into three functional segments to perform the supply chain analysis (Source of Supply, Distribution, and Storage);
- Leveraging a regionalized approach to best fit data points along DLA Energy's purchasing regions versus Combatant Command AORs;
- Capturing data from DLA Energy contracting applications and SME interview responses; and
- Assigning risk ratings for normal and surge operations based upon probability and consequence.

ODASD(OE) and DLA Energy met in April of 2017 to present and discuss the results of the Global Risk Assessment Study. ODASD(OE) accepted the Risk Assessment results.

The Under Secretary of Defense (Comptroller), in coordination with ASD(L&MR), issued DLA Energy approval to extend the DLA Energy Accountable Property System (APS) beyond DLA's point of sale to the Services. DLA Energy hosted a workshop to demonstrate the newest version of the DLA Energy APS for interested Service parties including logistics, finance, and information services personnel. DLA currently uses the software to provide

financial oversight and internal controls for Defense Worldwide Working Capital Fund (DWWCF)-owned fuel up to the official point-of-sale (demarcation between DLA DWWCF and Service-owned fuel). Extending such capabilities to the Services will enable the Department to gain: 1) timely inventory and transaction accounting; 2) Audit Visibility on consumption; 3) accurate battlefield resupply requirements; and, 4) situational awareness/visibility on fuel distribution to other customers.

In January 2017, DLA Energy hosted the annual Joint Petroleum Seminar, which was attended by 109 participants from across the DoD petroleum community. Additionally, DLA Energy partnered with DASD(OE) to update the Joint Petroleum Training Course to include an Operational Energy module. This module explains the roles and responsibilities of DASD(OE), as well as how this office relates to petroleum management.

DLA Energy, DLA Office of Operations Research and Resource Analysis (DORRA)/Information, and the Operation and Center for Excellence in Distribution and Logistics (CEDLi) at the University of Arkansas are developing a DoD Global Bulk Petroleum Supply Network Simulation and Modeling tool. The purpose is to enable analysis of DoD requirements against commercial/military bulk petroleum networks in order to identify potential logistics options and capability gaps. The Global-Theater Logistics Supportability Assessment of Bulk Petroleum for Operational/Contingency Plans is a manual-spreadsheet process fragmented between Supported/Supporting CCMDs, Geographical Military Service Components and DLA Energy. The lack of a DoD Enterprise automated simulation/modeling tool hampers a global assessment and optimal alignment of resources. The modeling tool will be used during ARDENT SENTRY 2018, a Tier 1 Defense Support of Civil Authorities exercise, an East Coast Catastrophic hurricane scenario.

Lastly, with funding from the DLA Energy's Energy Readiness Program, the Army Tank Automotive Research, Development and Engineering Center (TARDEC) completed a project that evaluated an Army procedure for field blending of additives into commercial jet fuel. In many tactical operations areas, accessing MILSPEC fuel through contract support or mechanical additive injection is not feasible. To address this problem, this project aimed to determine the proper procedures required for hand mixing neat Jet-A with additives to produce MILSPEC fuel. TARDEC successfully demonstrated the procedure via hand additization and recirculation onboard a single M978A4 fuel tanker. Army Petroleum Center will codify the results with the issuance of a Fuels Technical Letter.

Air Force

Energy is essential to the combat capability of the Air Force and the successful

completion of missions, at home and abroad. As the Department of Defense's largest operational energy consumer, the Air Force is committed to identifying operational inefficiencies and outdated technologies to optimize operational energy usage and maximize combat capability.

Implementing policy guidance in Air Force Policy Directive (AFPD) 90-17, *Energy and Water Management*, and in alignment with the Air Force Strategic Master Plan, and the Air Force Energy Flight Plan, the Deputy Assistant Secretary of the Air Force for Operational Energy (SAF/IEN) drafted Air Force Instruction (AFI) 90-1702, *Operational Energy*, which supersedes portions of AFI 90-1701, *Energy Management*, and streamlines key operational energy compliance requirements necessary to maximize readiness and combat capability. AFI 90-1702 has completed informal coordination and is being finalized for formal coordination.

SAF/IEN also collaborated with Air Mobility Command (AMC)'s Fuel Efficiency Office and integrated energy messaging into the Global Ready Aircraft Commanders, Trend Review, and Action Committee courses. Additionally, two leave-behind flyers were created about changing KC-135 landing weight to lessen fuel dumping, and flying F-22 air-refueling speeds closer to max range to save flight hours and fuel. The KC-135 leave behind was presented to three courses at the Air University Pre-Command Training Track Week for Group commanders, and the F-22 leave behind was presented to students in Air Combat Command (ACC)'s Squadron Commanders courses. Additionally, Air Force Operational Energy established the Award for Excellence in Operational Energy Research and Innovation, recognizing the Air University student presenting the best OE research each year.

For the Air Force's Title X wargame, Global Engagement 2018 (GE 18), Air Force Operational Energy established an Energy Planner role within the Blue Force Command & Control, Communications, Cyber/Computers (C4) cell along with a Modeling and Simulation (M&S) Planner role in Game Design, Planning, and Adjudication. The SAF/IEN Energy Planner operates at the theater-level and complements the base-level Energy Planner played by the Air Force Petroleum Office (AFPET) and aerial refueling Energy Planner played by Air Mobility Command (AMC). The SAF/IEN Modeling and Simulation Planner was established to assist in the systematic specification and integration of Logistics (to include energy) into GE 18. Through this integration, Air Force Operational Energy helped ensure Air Force leadership takes OE into account during operational planning as well as when prioritizing Military Construction (MILCON) and platform investments.

In FY 2017, Air Force Operational Energy teamed with the ACC Air Operations Squadron, the Tanker Airlift Control Center, Air Force Flight Test Center and AMC/ACC test and evaluation offices to demonstrate the benefits of aerial refueling closer to receiver maximum range airspeed. Preliminary analysis shows that faster airspeed saved 9,350lbs of fuel and \$40,761 in costs per flight hour for the 3 F-22s and 1 KC-10 in the formation. This initiative could affect over 1,200 aircraft movements a year.

Further, Air Force Operational Energy conducted a cost of weight analysis and determined aircraft from one Major Command (MAJCOM) were routinely carrying excess fuel on training missions, which increases fuel burn rate without providing additional combat capability or improving training. Routinely landing with excess fuel also causes increased wear and tear on landing gear and brakes, which increases maintenance and reduces readiness. The analysis revealed that reducing fuel loads will create a potential annual savings of \$3.5M to \$4.0M. The results of this study informed MAJCOM leadership, and subsequent analysis revealed consistently reduced landing weights in Air Force operations.

SAF/IEN also is spearheading two initiatives to develop information systems and software applications to address outdated aerial refueling planning tools. The first initiative, developed by DIUx and called “Jigsaw,” is a tanker planning tool that has already transitioned tanker scheduling for the Al Udeid Combined Air Operations Center from whiteboards to a digital format. Air Force Operational Energy is funding further development of “Jigsaw” to optimize tanker scheduling/support for combat operations. The second initiative is a suite of applications for 618th Air Operations Center planners, that will optimize planning and execution of aerial refueling operations. Tanker scheduling optimization not only optimizes energy use, but also maximizes combat and training capabilities.

The Air Force introduced aft drag reduction devices to the C-17. Having successfully completed preliminary flight tests at Edwards AFB, the cost-effective solution of adding microvanes to the fuselage of C-17s can save the Air Force \$10M per year in fuel costs. The Air Force owns the data and designs for C-17 microvanes, which can be installed locally, with a return on investment under six months.

Air Force Operational Energy played an active role in the Capability Development process, and continually worked with requirement sponsors and program offices throughout 2017. In partnership with PACAF, Air Force Operational Energy participated in the KC-46 Energy Supportability analysis. This effort highlighted limitations and opportunities within the Pacific Theater, and paved the way for improved analytical tools and methodologies.

In FY 2017, Air Force Operational Energy focused on creating energy-optimized Air Force that maximizes combat capability for the warfighter through multiple lines of effort including technology and process improvements. Through a robust, resilient, and ready energy posture, the Air Force will enable warfighters, expand operational effectiveness in air, space, and cyberspace, and provide mission assurance through energy assurance.

Army

The Army considers energy to be a key enabler of military capabilities, extending range

and endurance, enhancing movement and maneuver, supporting freedom of action, and reducing risks and costs. As such, energy security – assured access to reliable supplies and the ability to distribute to meet mission needs – is a critical requirement for military operations.

In January and February 2017, the Army published updates to the six key Army Functional Concepts (Mission Command, Intelligence, Movement and Maneuver, Fires, Sustainment, and Protection). The Army Functional Concepts describe the capabilities the Army must have to conduct the full range of military operations in the expected operational environment.

The Army envisions a future where units will be expected to operate with a high degree of dispersion in a complex and lethal battlespace for up to seven days, semi-independently from their source of supply, and at the end of contested strategic lines of communication. Soldiers must be able to operate for increased periods, over greater distances, and at a high operational tempo, with decreased load. The Army Functional Concepts acknowledge that semi-independent and dispersed operations require a fundamental reduction in demand, with the most significant demands being those for fuel, water, and ammunition. The Army's operational energy efforts seek to reduce the demand characteristics of the force and provide operational energy more effectively.

To achieve this, the Army will use energy more effectively, increase the energy efficiency of its platforms, devices, and equipment to support extended operational reach and prolong endurance. Further, the future Army works to institutionalize operational energy power management, using energy management plans at all levels, while also integrating energy control and accountability systems with mission command systems.

The Army's operational energy initiatives are creating a more capable future force by upgrading or replacing the majority of the combat vehicle fleet to improve lethality, mobility and protection, and provide the power needed for current and future capabilities. These capability improvement efforts in both mounted and dismounted programs directly address the challenge to use energy more effectively. Some examples of Army initiatives in FY 2017 are:

- The M-1A2SEPV3 Abrams tank entered production. This improvement provides additional electrical power and improved distribution. A separate under-armor auxiliary power unit provides electrical power at the halt instead of using the main engine, and is expected to reduce overall fuel consumption by 8 percent. In addition, the Army continued development of the Advanced Reliability and Cost Savings (ARCS) components for the engine in the Abrams with a target of field-testing in FY2018. An ARCS-equipped engine is expected to reduce Abrams fuel consumption by 14 percent to 20 percent, improving battlefield range.
- Bradley Fighting Vehicle Engineering Change Proposals (ECPs). The Bradley ECP upgrades restore the performance of the vehicle that were lost after several years of

increasing weight and electrical demands from the addition of new capabilities. By improving the track system, upgrading the powertrain, and improving electrical generation and distribution, the Bradley regains lost mobility, while providing sufficient electrical power for current and all future planned capabilities.

- Stryker vehicle upgrades are focused on technologies that will provide the platform a stronger engine, improved suspension, more on-board electrical power, and next-generation networking and computing technology. Combined, the Stryker regains mobility lost as protection requirements increased, and provides sufficient electrical power to integrate and sustain current and future capabilities.
- The M109A7 Paladin Self-Propelled Howitzer and M992A3 Carrier Ammunition Tracked continued in low-rate initial production in FY2017. This next-generation Howitzer is a modernization effort to improve the size, weight, power, cooling, readiness, force protection and survivability, and to increase sustainability of the vehicles. By using components from the Bradley Infantry Fighting Vehicle program, including the engine, transmission, and final drive, the Paladin is able to keep pace with other vehicles in the Armored Brigade Combat Team, while the new electrical system enables the replacement of most hydraulic components, increasing the system's accuracy, improving reliability, and simplifying maintenance.
- The Improved Turbine Engine Program (ITEP) for the Apache and Blackhawk helicopters continued modeling and design in FY 2017. The ITEP will improve operational effectiveness by giving commanders a significantly increased capability with longer loiter time, increased altitude limits, increased payload, lower fuel requirements, and lower maintenance costs.
- The Army's S&T activities continued to provide the future Army with the capabilities to conduct prompt, sustained, and synchronized operations with a force customized to the mission and poised to prosecute both combat and noncombat missions in all functional domains – air, ground, maritime, space, and cyberspace.

In addition, the Army recognizes the criticality of Army installations is support of readiness. Secure access to energy, water and land, and resilient infrastructure allow the Army to generate readiness, project power at will, and sustain operations. To support the growing criticality of resource security on installations to project power and support operations, in February 2017 the Army published the Installation Energy and Water Security Policy. The policy requires the Army to prioritize energy and water security requirements at the installation level, to ensure energy and water are always available to continuously sustain critical missions. It specifically requires the Army to provide energy and water for installation operations for a minimum of 14 days in the event that primary supply infrastructure fails. To support the requirement, the Army will develop diverse sources of supply, ensure redundant supply networks are available, and personnel are trained to provide planning and operational support for sustainment activities.

Department of the Navy

Navy

The Navy Energy Program addresses energy as a strategic resource that is essential to the successful execution of Navy's afloat and ashore missions. Our goal is to increase operational capability and shore resilience by decreasing the Navy's reliance on petroleum, while increasing the use of alternative energy sources, where cost effective, in order to support increased operational flexibility. The Navy Energy Strategy encompasses robust investments in people, technology, and programs 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.

As a Navy, we are cultivating a new generation of "energy warriors" through incentives and education. The Energy Conservation (ENCON) program encourages ships to apply energy efficient procedures and operations during all suitable ship missions, whether underway or in port, resulting in energy cost avoidance. In FY 2017 the Aircraft Energy Conservation Program (AirENCON) implemented standard operating guidance and other tools to optimize fuel consumption on the Navy's 3,700 aircraft.

Behavioral change efforts extend from shipboard and aircraft applications and into the classroom. The Naval Postgraduate School (NPS) offers four master's degree programs and graduate certificates with an energy focus for Navy and Marine Corps personnel; Master of Science (MS) in Operational Analysis, Naval/Mechanical Engineering, Electronic Systems Engineering, and Financial Management. In FY 2017, the Navy also continued with its Energy General Military Training (GMT) that achieved 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 Electric Propulsion System (HED EPS), are used when tactically appropriate, and deliver savings only while in use. Actionable technologies include the Shipboard Energy Dashboard, which provides real-time situational awareness of the energy demand associated with equipment onboard to enable optimized energy performance. In FY 2017, Navy continued solid state lighting upgrades 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. The first installation of an HED EPS for initial fielding testing on one DDG 51 class ship began in late 2017. Stern Flaps are installed on all guided missile

cruisers (CG) and destroyers (DDG), and certain amphibious ships (LHD, LPD, LSD). Energy Dashboards have been installed on 18 DDGs and will be installed on an additional two DDGs in FY 2018. Combustion Trim Loops are now installed on eight amphibious ships, including LHD 1-7.

Aircraft engine research is focused on new turbine engine configurations using innovative materials and processes to produce improved components to decrease fuel consumption, as well as acquisition and maintenance costs, 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. For aviation, the Navy's Fuel Burn Reduction (FBR) initiative for the F-35 completed all stationary tests early in calendar year 2017. The Navy also continued its investments in trim-optimizing flight control for F/A-18 and F-35, and commended a project to evaluate potential energy efficiency and performance improvements to the F414 engine of the F/A-18E/F Super Hornet. The AirENCON program continued implementation of standard operating guidance (SOG) documents and other tools for use by the Fleet to optimize fuel consumption on the Navy's 3,700 aircraft.

The Navy continues to evaluate the technical feasibility of cost-effective alternatives for diversifying its energy supply and increasing flexibility. The Department of the Navy (DON) mandated that alternative fuels must be interchangeable with and capable of being fully blended with petroleum without any changes to current aircraft or ship systems. Accordingly, the Navy has qualified fuels of various types to MILSPECs, including testing and qualification and approved MILSPECs for JP-5, JP-8, and F-76 for the Hydrotreated Esters and Fatty Acids (HEFA) and Fischer-Tropsch (F-T) pathways, which will enable widespread use by both aircraft and ships. Drop-in compatible fuel blends produced through these two processes will be eligible for use in operational quantities once they become cost competitive with conventional fuels.

Marine Corps

In the Marine Corps Operating Concept (MOC), 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 [Marine Air Ground Task Force] (MAGTF)." This capstone concept 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 is critical to including energy consideration across the entire Marine Corps. In addition to the release of the MOC, the subsequent release of Littoral Operations in a Contested Environment (LOCE) and the draft Expeditionary Advanced Base Operations (EABO) concept lead the Marine Corps toward a more distributed posture on the battlefield requiring more agile logistical support for energy.

To better understand operational energy risks to warfighting, the USMC is increasing efforts to improve the role of energy in wargames, concepts, and plans, beginning with an assessment of energy-related risks in specific Marine Corps Operational Plan. Preliminary OPLAN analysis identified capability gaps similar to those found during analysis of other warfighting scenarios. This growing body of analysis confirms and quantifies the gaps being addressed in the Marine Corps capability development process. The Marine Corps continues to identify opportunities to leverage modeling and simulation to assess operational energy-related risk in OPLANs and Defense Planning Scenarios.

In the area of capability development, the Marine Corps is moving forward with efforts that span from science and technology through fielding of acquisition programs. These efforts are coordinated with the other services as well as efforts led by the Office of the Secretary of Defense. The Marine Corps is continuing to team with the Army and the support of OSD OE on the Joint Operational Energy Command and Control (JOEC2) project. JOEC2 will increase operational reach of the MAGTF by enabling a commanders' understanding of, and influence on, unit energy performance. The JOEC2 operational demonstration and development plan is an accelerated and concurrent requirements development and user feedback process to ensure the right capabilities are available to expeditionary warfighters at the earliest opportunity. While previous demonstration efforts focused on maneuver units and individual vehicles, the FY 2017 efforts refined the focused to bulk fuel storage and distribution assets as visibility and understanding of bulk fuel enables more effective usage of energy.

In FY 2017, the Marine Corps initiated the Mobile Amphibious Assault Fuel Distribution (MAAFD) experimentation program to identify mitigation options for the ship-to-shore bulk fuel distribution gaps identified in previous warfighting analyses. MAAFD experimentation is being conducted to demonstrate capabilities to increase the MAGTF's operational reach and enable naval support to naval concepts like LOCE and EABO as well as support to Navy concepts like Operational Logistics in a Contested Maritime Environment. These MAAFD capabilities will reduce the energy-induced risks by enabling the force to establish and sustain distributed operations despite persistent threats in the littorals. Developing flexible and scalable fuel distribution capabilities is critical to supporting distributed operations and the efforts include modeling and simulation to identify capability gaps, conducting limited technical assessments, experimenting in operational exercises, and developing concepts of employment. Demonstration efforts will assess novel bulk fuel storage and delivery methods that range from large fuel barges down to tactical fuel delivery at the vehicle level and will also assess movement of fuel, equipment, and personnel via air, land, and sea. MAAFD is focused on conducting ascending levels of demonstrations in FY 2018-19 culminating within the Marine Corps Warfighting Laboratory's MAGTF Integrated Experiment in FY20.

In FY 2017, the USMC continued to identify and field new OE-related equipment to increase the operational reach and lethality of the MAGTF. Recent improvements included the

transition of the S&T Fuel-Efficient Medium Tactical Vehicle Replacement (MTVR) program to PEO Land Systems for implementation, and the development of a Lithium Ion battery power pack to support the Network On The Move communication system on select tactical vehicles.

The Marine Corps also continued development of a Marine Corps Energy Order that delineates responsibilities, directs the implementation of energy considerations in force development, training, and education, and institutes a mandate for energy accountability for units, commanders, and Marines. Signature and release of the order is expected in the second quarter of FY 2018.

Finally, the Marine Corps is adapting the training and education of Marines. The first goal is to integrate operational energy considerations into the Motor Transportation (MOTOR-T) Formal Learning Centers. Motor-T is the first Military Occupational Specialty (MOS) to be targeted as they are the largest user of fuel on the ground and the second largest MOS in the Marine Corps. Institutionalizing optimization of operational energy in day to day operations as well as consideration of energy in operational planning for the Motor-T community will help increase the operational reach of the MAGTF. In FY 2017, the Marine Corps worked closely with the MOTOR-T Formal Learning Center to review curricula and identify places to integrate operational energy into the existing curriculum. Final integration of OE in Motor-T training is planned for FY 2018.

In conclusion, the Marine Corps is working both from the top down via the identification of operational energy risks at the operational level, and from the bottom up by modifying individual Marine behavior via improved training. These combined efforts are designed to improve the effectiveness of energy use, and ultimately increase the operational reach of the MAGTF, providing a more combat effective force.

Combatant Commands

OASD(EI&E) continued to coordinate with the Combatant Commands 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:

- Pacific Command (PACOM). PACOM coordinated with EI&E and PACOM to address PACOM efforts with grid security. The intent is to promote awareness of PACOM's efforts to OE and other organization under the DoD umbrella and to elevate the requirement as a Joint Rapid Acquisition Cell (JRAC) procurement to sustain the program.
- Central Command (CENTCOM). ODASD(OE) has provided an Operational Energy advisor to CENTCOM to increase knowledge of OE concepts and champion OE related issues to include increased reach and resilience of forces operating in the

AOR.

- Africa Command (AFRICOM). AFRICOM coordinated with ODASD(OE), Rapid Innovation Fund (RIF), National Defense Center for Energy and Environment (NDCEE), and Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL) to develop innovative technology to reduce fuel consumption in field operations. AFRICOM developed this technology by collaborating with RIF and NDCEE to fund two hybrid battery storage prototypes. AFRICOM also partners with Project Manager Expeditionary Energy Systems (PM E2S2) on the feasibility of installing micro-grid electrical systems at posture locations in Africa.

Conclusion

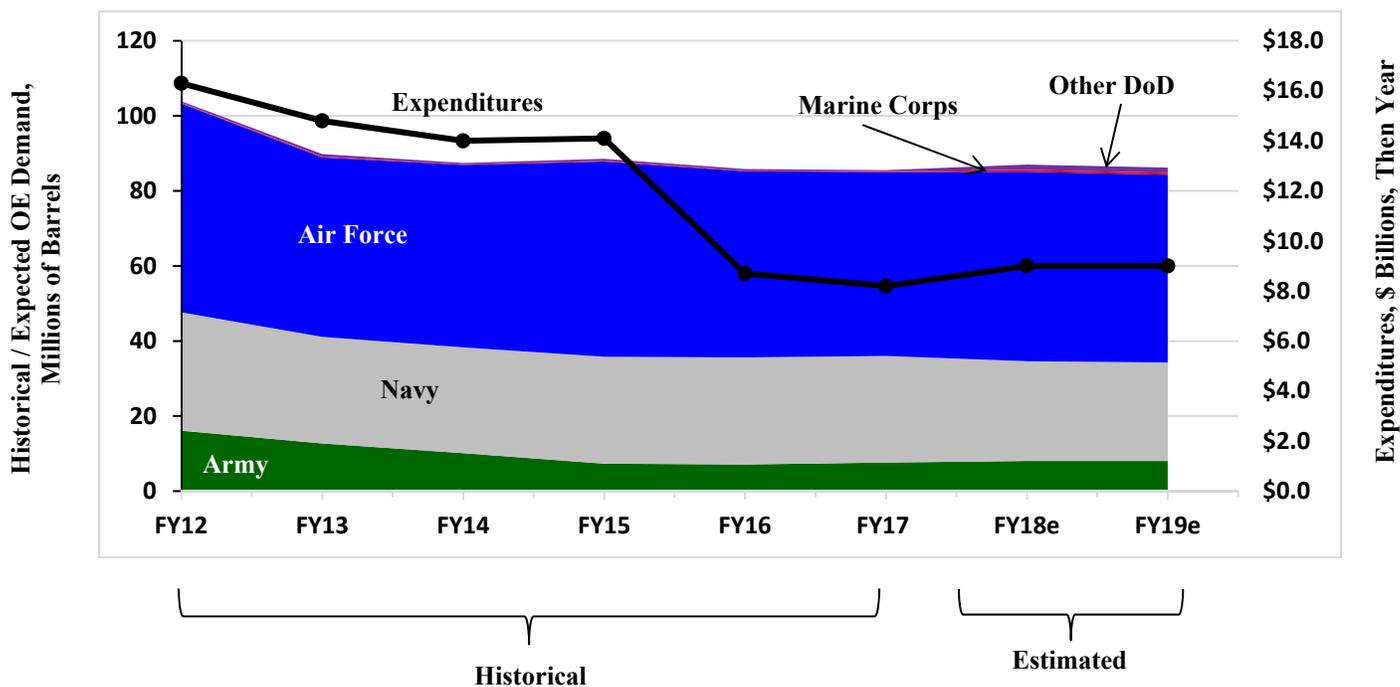
The *National Defense Strategy* (NDS) outlined a challenging operating environment and specified the need to enhance “forward force maneuver and posture resilience” and “resilient and agile logistics” in contested environments. As a result, the Department will need to think differently about how we will deploy, employ, and sustain forces with the energy needed to conduct worldwide missions. The shift toward strategic competition with Russia and China means that the energy role will only grow, even as these adversaries develop multi-domain threats to the delivery of energy. The Department investments and initiatives reviewed in this report will increase the resilience of the force against emerging threats and enable the successful implementation of the NDS.

Looking ahead to FY 2018, the Department and Services will focus on the goals of the NDS through resilient fuel infrastructure, agile logistics, and contingency base efficiencies. Including wargames, new propulsion technologies, targeted research and development, and platform upgrades, the Department is committed to improving the lethality of our forces in a changing and contested operational environment.

Appendix A: Historical and Estimated Demand for Operational Energy

Figure 1 and Table 2 below describe the historical demand for operational energy in FY 2012–2017, estimated demand for operational energy in FY 2018-2019, and total expenditures to purchase that fuel. Historical operational energy demand is based on net sales of selected liquid fuels by DLA Energy to the Services, while future operational energy demand estimates are based on the FY 2018 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.²

Figure 1: DoD Operational Energy Demand, FY 2012 – FY 2019e³



² Standard DLA Energy fuel prices can be found at <http://www.dla.mil/Energy/Business/StandardPrices.aspx>

³ 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

		FY12	FY13	FY14	FY15	FY16	FY17	FY18e	FY19e
Operational Energy Demand, Million Barrels	Army	16.1	12.7	10.1	7.3	7.1	7.6	8.0	8.0
	Navy	31.5	28.4	28.2	28.5	28.5	28.4	26.6	26.3
	Air Force	55.7	47.8	48.6	52.0	49.6	49	50.5	50.0
	Marine Corps	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1
	Other DoD	0.4	0.7	0.3	0.5	0.4	0.3	1.4	1.4
	<u>Total Demand</u>	103.9	89.8	87.4	88.6	85.7	85.5	87.0	86.2
	<u>Expenditures, \$ Billions</u>	\$16.3	\$14.8	\$14.0	\$14.1	\$8.7	\$8.2	\$9.0	\$9.0

1 Appendix B: Alternative Fuels Initiatives

2
3 Testing and Evaluation: DoD alternative fuels activities include testing and evaluating,
4 production, and procurement. The Department understands that drop-in alternative fuels—fuels
5 produced from feedstocks other than petroleum—may be comingled into the commercial fuel
6 supply chain the military relies on, may be available in locations where petroleum fuel supplies
7 are scarce, and/or may have characteristics that alter performance and/or maintainability of
8 military platforms. As a result, the DoD’s FY 2017 alternative fuels RDT&E investments
9 predominantly focused on test and evaluation (T&E) in support of the qualification and
10 certification of fuels produced through new alternative fuel pathways.

11
12 In FY 2017, subject matter experts from the Army, Navy, Air Force, and DLA Energy
13 continued to support and complement drop-in alternative fuel T&E work sponsored by the
14 Federal Aviation Administration (FAA), ASTM International, and the Commercial Aviation
15 Alternative Fuels Initiative (CAAFI). One major initiative led by the FAA is the National Jet
16 Fuels Combustion Program (NJFCP), an interagency and commercial industry group focused on
17 developing and improving combustion models that enable new alternative fuels to be more easily
18 screened and qualified for aviation fuel specifications. Much of the work for NJFCP takes place
19 at the Air Force Research Laboratory (AFRL) with funding from outside sources. The Military
20 Services’ (DoD-funded) certification and qualification programs are coordinated through the Tri-
21 Service Petroleum, Oils, and Lubricants Users Group (TRIPOL), which reviews data from
22 ASTM International and equipment manufacturers. This review then informs the DoD’s
23 airworthiness authorities on the decision to review and approve a new fuel pathway given the
24 existing available data, or to invest in supplemental fuel evaluation and data collection on a new
25 fuel pathway. The primary FY 2017 activities of the Military Services, as presented in **Tables 3**
26 **and 4**, include:

- 27
28
- 29 • Army: For ground platforms, the Army continued to support the T&E of
30 alternative jet fuel pathways that have been (or are expected to soon be) approved
31 by ASTM International. For air platforms, the Army has not funded T&E of
32 alternative jet fuels since FY 2014.
 - 33 • Navy: For aviation and sea platforms, the Navy continued T&E of drop-in
34 alternative fuel pathways for potential inclusion in the specifications for JP-5 and
35 F-76 fuels, both of which are managed by the Navy. In September 2017, the
36 Navy updated the fuel specification for F-76 to permit up to 20 percent blends of
37 synthetic isoparaffin, as presented in **Table 5**.
 - 38 • Air Force: Other than providing in-kind and work-for-others support for
39 international and interagency alternative jet fuel T&E initiatives, the Air Force
has not funded alternative jet fuel T&E since FY 2013.

- DLA Energy: DLA Energy’s Energy Readiness Program (ERP) provided partial funding for AFRL’s work in support of the NJFCP.

Production: In the fall of 2014, three \$70 million Defense Production Act Title III Phase 2 awards were announced for the construction of facilities capable of producing at least 10 million gallons per year of MILSPEC biofuels. The source of funds for these awards included FY 2012 and FY 2013 funding from OSD and Navy, respectively, and additional funding from the DOE. On October 27, 2017, Fulcrum Sierra Biofuels reached financial close (required to commence Phase 2), after having already completed and operated their feedstock (municipal solid waste) processing facility at full capacity in 2017. On December 27, 2017, Red Rock Biofuels also reached financial close. Both companies expect to break ground in 2018, and achieve routine fuel production by 2020. The third company that was offered a Phase 2 award, Emerald Biofuels, did not achieve financial close by the end of 2017.

Procurement: Through statute and policy, drop-in alternative fuels procured for use in operations are purchased when compatible with existing equipment and infrastructure and cost-competitive with traditional fuels. The Department’s solicitations for bulk fuels provided in or after FY 2016 have been open to fuels that include blends of alternative fuel pathways consistent with the fuel specifications presented in Table 5. Approximately two years after DLA Energy’s first bulk fuel contract award that incorporated blends of drop-in alternative fuels, it made a second such award in July 2017. In both cases, awards were made to AltAir Paramount in California to supply F-76 that contained bio-based hydroprocessed esters and fatty acids (HEFA) fuel, which is derived from renewable fats, oils, and greases. Altair supplied a 30 percent bio-based F-76 blend under its 2017 contract, which was an \$86 million award for supply of 60 million gallons of F-76 at a price of \$1.43/gallon, to be supplied between October 1, 2017 and September 30, 2018.

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 2017 Funding
Navy	Defense Research Sciences	Naval Biosciences: Biosynthesis of Liquid Fuels	Develop transformational approaches using living organisms to produce fuel components (e.g., alkanes)	1319	01		0601153N	0
Navy	Bio-Centric Technology (Energy)	Biosynthesis of Liquid Fuels	Develop transformational approaches using living organisms to produce fuel components (e.g., alkanes)	1319	02		0602236N	446
Navy	Synthetic Biology for Sensing and Energy Production	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	Synthetic Biology for Sensing and Energy Production	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								946

Table 4. Initiatives to Test and Evaluate Alternative / Non-Petroleum Fuels for Use in Military Fuel Systems⁴
(Dollars in Thousands)

Service	Program Title	Initiative Title	Description	Treasury Code (TC)	Budget Activity (BA)	Budget Line Item	Program Element (PE)	FY 2017 Funding
Air Force	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.					50 ⁵
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	730
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	920
DLA Energy	Quality/Technical Support Office – Energy Readiness Program	Effect of Alternative Jet Fuels on Combustor Operability Limits	This project is evaluating 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	181
Subtotal								1,881
Total Expenditure in FY 2017								2,827

⁴ These initiatives include the procurement of alternative fuels to support testing and evaluation activities.

⁵ 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-16884P
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	Sep 2017
SIP	20%				Sep 2017
FT-SPK/A	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)

SPK/A = Synthetic Paraffinic Kerosene plus Aromatics

Appendix C: Operational Energy Capability Improvement Fund (OECIF)

The Operational Energy Capability Improvement Fund (OECIF) is categorized as a Research, Development, Test, and Evaluation Program Element, Budget Activity 3 (Advanced Technology Development) appropriation (“6.3”).⁶ The fund generally supports projects that aim to mature operational energy technologies with Technology Readiness Level (TRL) values ranging from 4, characterized by basic technology component or breadboard validation in a laboratory environment, to TRL 6, characterized by a model or prototype system tested in a relevant environment.

The OECIF was established in Fiscal Year (FY) 2012 and is overseen by the Office of the Deputy Assistant Secretary of Defense for Operational Energy (ODASD(OE)). The purpose of the fund is to act as “seed money” to start or consolidate promising operational energy initiatives that improve the Department’s operational effectiveness. Once OECIF funding is exhausted, program funding shifts to the identified transition partner, which is generally the Services, but also can be the Combatant Commands or the Office of the Secretary of Defense (OSD).

OECIF projects are selected annually from Military Service and Combatant Command proposals that align with the Department’s *Operational Energy Strategy* and support that fiscal year’s OECIF theme. Since the inception of the OECIF, the ODASD(OE) annually identifies one or more specific themes to reflect Departmental priorities and focus science and technology (S&T) investments. OECIF projects typically receive four years of funding, but are managed, executed, and transitioned by the Military Services or Combatant Commands under ODASD(OE) oversight.

Since FY 2012, OECIF has funded a series of projects, as shown in Table 6. By the end of FY 2017, 13 projects had concluded that began in FY 2012, FY 2013, and FY 2015. Twelve of the thirteen projects were successful,

Table 6. OECIF Programs, FY 2012-18

Start Year	Theme	Projects Funded
FY 2012	Reducing energy load at expeditionary outposts	6
FY 2013	Using consortia to attack key operational energy problems	4
FY 2014	Developing operational energy analytical methods and tools	6
FY 2015	Improving fuel economy for the current tactical ground fleet	4 ----- 10*
FY 2016	Increasing the operational energy performance of unmanned systems	6 ----- 4*
FY 2017	1) Thermal and power management technologies for high pulse power systems 2) Wireless transmission of energy in the far-field	6 ----- 4*
FY 2018	One-year studies to identify operational energy science and technology gaps in the near-, mid-, and far-term	TBD

* Funded with a Congressional plus-up; topics vary

⁶ Advanced Technology Development demonstrates the general military utility or cost reduction potential of technology when applied to different types of military equipment or techniques (DoD 7000.14-R, Financial Management Regulation).

both from a technical and transition perspective, and their transition partners have either already funded or will continue to fund their efforts.

Some examples of the completed projects are:

- The Super Energy Efficient Containerized Living Unit Design and Development project developed variants of living units, now being used by the Navy, with energy efficiency improvements up to 82 percent;
- The Soldier and Small Unit Operational Energy Consortium developed tools to reduce or optimize the dismounted warfighter's physical load related to worn power and energy. These tools are being maintained by the Army to influence development and fielding of future dismounted warfighter power and energy components and systems; and
- The Behavioral Energy Operations Demonstration project Phase I effort determined that savings of 9 to 20 percent may be possible at remote bases and up to 10 percent in vehicles in a tactical environment through behavior change interventions at little to no cost. The Navy is funding Phase II of this effort to test the recommended interventions.

In FY 2017, OECIF continued to provide funding for initiatives that started in FY 2014 - 16, as well as providing funding for FY 2017 new starts. The FY 2017 new starts are intended to improve the thermal and power management of high pulse power systems to enable the use and integration of directed energy weapons onto existing platforms. Additionally, a second theme was included to further investigate technologies that wirelessly transfer power to unmanned vehicles and contingency bases.

Appendix D: Recommend Change in Organization or Authority

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

Appendix E: FY 2017 Operational Energy Initiatives (Dollars in Thousands)

Table 8. Air Force FY 2017 Operational Energy Initiatives (Dollars in Thousands)

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Aerospace Propulsion	Fuel Assessment and Evaluation	Evaluate advanced fuels for performance, environmental impact and system operations	Reduce Logistics Risks to Mission	Conventional Fuels Testing	3600	02	0602203F	4,847	4,502	23,448
Air Force	Aerospace Propulsion and Power Technology	Fuel Assessment and Evaluation	Demonstrate fuels for performance, environmental impact and system operations	Increase Warfighter Capability	Conventional Fuels Testing	3600	03	0603216F	2,267	2,262	11,778
Air Force	Human Effectiveness Applied Research	Support for Planning of Air Refueling Tasking and Allocation (SPARTA) Phase 2	Provide next generation decision support tools to enable more efficient air refueling	Enhance Mission Effectiveness	Current Operations Tools	3600	03	0603456F	98	99	189
Air Force	Aerospace Propulsion and Power Technology	Surfing Aircraft Vortices for Energy (SAVE) Formation Flight Advanced Technology	This ATD will build upon the Surfing Aircraft Vortices for Energy (SAVE) flight demonstration conducted on the C-17 Block 18 aircraft.	Enhance Mission Effectiveness	Current Operations Tools	3600	03	0603211F		607	607
Air Force	Materials	2700F SiC Composites for Turbine Hot Section Components	Program will develop, demonstrate subscale, and predict behavior and life of SiC/SiC composites for application in the hot-section of advanced turbine engines to 2700°F, and 3000°F with a coating. Additional applications are in liquid rocket engines, scramjet engines and thermal protection systems.	Increase Warfighter Capability	Materials and Design	3600	02	0602102F		1,686	2,106
Air Force	Advanced Materials for Weapon Systems	2700F SiC SiC Composites for Turbine Hot Section Components	Program will develop, demonstrate subscale, and predict behavior and life of SiC/SiC composites for application in the hot-section of advanced turbine engines to 2700°F, and 3000°F with a coating. Additional applications are in liquid rocket engines, scramjet engines and thermal protection systems.	Increase Warfighter Capability	Materials and Design	3600	03	0603112F		3,257	4,977

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Materials	Advanced CMC Lifing	Community desire for precompetitive collaboration on performance, life modeling, and NDE of CMCs. Need physics based tools for predictive damage tolerance approach (i.e., damage initiation and growth) that can capture nuances of sub-component/component features (e.g., ply drops).	Increase Warfighter Capability	Materials and Design	3600	02	0602102F		-	5,936
Air Force	Advanced Materials for Weapon Systems	Advanced CMC Lifing	Community desire for precompetitive collaboration on performance, life modeling, and NDE of CMCs. Need physics based tools for predictive damage tolerance approach (i.e., damage initiation and growth) that can capture nuances of sub-component/component features (e.g., ply drops).	Increase Warfighter Capability	Materials and Design	3600	03	0602102F		-	1,264
Air Force	Defense Research Sciences	Aerospace Materials for Extreme Environments	The objective of basic research in Aerospace Materials for Extreme Environments is to provide the fundamental knowledge required to enable revolutionary advances in future U.S. Air Force technologies through the discovery and characterization of materials for extreme temperatures (exceeding 1000°C), other extreme environments of stress-, magnetic-, electric-, microwave-, and ultrasound fields. Interest domain includes the fundamental science of single crystals, heterogeneous structures, interface of phases and grain boundaries. Materials of interest are ceramics, metals, hybrid systems including inorganic composites that exhibit superior structural, functional and/or multifunctional performance.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F		9,457	48,657
Air Force	Aerospace Vehicle Technologies	Composite Certification	Develop, apply, and demonstrate methodology for verifying the reliability of composite structures as predicted to allow a more widespread use of composite structures to future systems such as Future Air Dominance and Next Gen Mobility.	Increase Warfighter Capability	Materials and Design	3600	02	0602201F		11,331	44,333
Air Force	Aircraft Sustainment	Composite Certification	Develop, apply, and demonstrate methodology for verifying the reliability of composite structures as predicted to allow a more widespread use of composite structures to future systems such as Future	Increase Warfighter Capability	Materials and Design	3600	03	0603199F		5,433	34,758

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
			Air Dominance and Next Gen. Mobility.								
Air Force	Materials	Composites Certification	Development, maturation & integration of processing, performance & lifting tools for advanced composite, hybrid & multifunctional materials to support transition & certification Address cradle-to-grave certification Enable transition/certification	Increase Warfighter Capability	Materials and Design	3600	02	0602102F		1,062	1,062
Air Force	Defense Research Sciences	Dynamic Materials and Interactions	The objective of the Dynamic Materials and Interactions portfolio is to develop fundamental scientific knowledge of the dynamic chemistry and physics of complex materials, particularly energetic materials. The portfolio focuses on energetic materials science and shock physics of heterogeneous materials. Research supported by this portfolio seeks to discover, characterize, and leverage (1) fundamental chemistry, physics, and materials science associated with energetic materials; and (2) fundamental shock physics and materials science associated with complex, heterogeneous materials. The research will be accomplished through a balanced mixture of experimental, numerical, and theoretical efforts. This is required for revolutionary advancements in future Air Force weapons and propulsion capabilities including increased energy density and survivability in harsh environments.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F		5,527	28,437
Air Force	Materials	Flexible Materials and Processing Research Team	Dev lightweight, flexible, and integrated mtl solutions for adv thin film energy harvesting and storage devices and integrated flexible electronic components. Applications include lightweight power for deployed operations, mechanically robust electronics, and devices for human perf monitoring.	Increase Warfighter Capability	Materials and Design	3600	02	0602102F		2,535	9,415

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Defense Research Sciences	GHz-THz Electronics and Materials	The objectives of this program include development of low-power electronics based on two-dimensional materials, such as graphere, MoS2, and BN. Such electronics can greatly reduce energy consumption and reduce component sizes, allowing addition of more payloads and weapons. It also includes research on ultrawide-bandgap semiconductors, which could lead to higher-efficiency, higher-power components, including directed-energy weapons.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F		6,651	34,221
Air Force	Materials	Integrated Comp Methods for Composite Materials (ICM2)	This Integrated Computational Materials Engineering program will demonstrate the ICME methodology of linking composite material processing, property, structure relationships for material design to account for processibility, manufacturability, system performance and sustainability.	Increase Warfighter Capability	Materials and Design	3600	02	0602102F		3,610	3,610
Air Force	Defense Research Sciences	Low Density Materials	The AFOSR Low Density Materials portfolio supports transformative, basic research in materials design and processing to enable weight reductions with concurrent enhancements in performance and function. Can transform the design of future U.S. Air Force aerospace and cyber systems for applications which include airframes, space vehicles, satellites, and load-bearing components and systems.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F		7,392	38,032
Air Force	Defense Research Sciences	Mechanics of Multifunctional Materials + Microsystems	The main goals of this program are (a) to promote the utilization of newly emerging materials, nano-devices and microsystems in multifunctional design of advanced structures for higher system efficiency, (b) to bridge the gap between the viewpoints from materials science on one side and structural engineering on the other in forming a scientific basis for the materials	Increase Warfighter Capability	Materials and Design	3600	01	0601102F		7,561	38,904

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
			development and integration criteria, and thereby (c) to establish safer, more maneuverable aerospace vehicles and platforms with unprecedented performance characteristics.								
Air Force	Aerospace Technology Development /Demonstration	Next Generation Mobility	Next Generation Mobility efficient aerodynamics and propulsion integration technology maturation. The objective of this program is to develop and mature advanced aerodynamics technologies for Next Generation Tanker and Next Generation Transport concepts.	Increase Warfighter Capability	Materials and Design	3600	03	0603211F		202	53,333
Air Force	Aerospace Vehicle Technologies	Next Generation Mobility	Next Generation Mobility efficient aerodynamics, propulsion integration technology maturation, and advanced structures technology maturation. The objective of this program is to develop and mature advanced aerodynamics technologies for Next Generation Tanker and Next Generation Transport concepts. The objective of this program is to develop and mature advanced lightweight and adaptive structures technologies for Next Generation Tanker and Next Generation Transport concepts.	Increase Warfighter Capability	Materials and Design	3600	02	0602201F		4,722	31,436
Air Force	Advanced Materials for Weapon Systems	Next Generation Turbine Engine Disk System	Increase temperature capability of propulsion disk materials. Mature and implement site specific tech and tools. Increase T3 temperatures, increase efficiencies, mature joining technologies, provide critical design data and durability models	Increase Warfighter Capability	Materials and Design	3600	03	0603112F		4,627	6,589
Air Force	Advanced Materials for Weapon Systems	Next Generation Turbine Engine Disk System II	Increase temperature capability of propulsion disk materials. Mature and implement site specific tech and tools. Increase T3 temperatures, increase efficiencies, mature joining technologies, provide critical design data and durability models	Increase Warfighter Capability	Materials and Design	3600	03	0603112F		4,627	9,027

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Materials	OMC Processing-to-Performance Research and Analysis	New manufacturing methods (bonded, infusion) and material forms (textiles, 3-D braiding) are being proposed to enhance future systems. Current SOTA tools do not account for multiphysics interactions or environmental effects in addition to thermomechanical structural response.	Increase Warfighter Capability	Materials and Design	3600	02	0602102F		-	3,712
Air Force	Advanced Materials for Weapon Systems	OMC Processing-to-Performance Research and Analysis	New manufacturing methods (bonded, infusion) and material forms (textiles, 3-D braiding) are being proposed to enhance future systems. Current SOTA tools do not account for multiphysics interactions or environmental effects in addition to thermomechanical structural response.	Increase Warfighter Capability	Materials and Design	3600	03	0602102F		-	4,206
Air Force	Defense Research Sciences	Organic Materials Chemistry	The goal of this research area is to achieve unusual properties and behaviors from polymeric and organic materials and their inorganic hybrids through a better understanding of their chemistry, physics and processing conditions. This understanding will lead to development of advanced organic and polymeric materials for future U.S. Air Force applications. This program's approach is to study the chemistry and physics of these materials through synthesis, processing control, characterization and establishment of the structure properties relationship of these materials. There are no restrictions on the types of properties to be investigated but heavy emphases will be placed on unusual, unconventional and novel properties. Research concepts that are novel, high risk with potential high payoff are encouraged. Both functional properties and properties pertinent to structural applications will be considered. Materials with these properties will provide capabilities for future Air Force systems to achieving global awareness, global mobility, and space operations.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F		8,195	42,163

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Defense Research Sciences	Plasma and Electro-Energetic Physics	The objective of this program is to understand and control the interaction of electromagnetic energy and charged particles to produce useful work in a variety of arenas, including directed energy weapons, sensors and radar, electronic warfare, communications, novel compact accelerators, and innovative applications of plasma chemistry, such as plasma-enhanced combustion. While the focus of this effort is the generation and collective interaction of electromagnetic fields and plasmas, advances in the enabling technology of compact pulsed power, including innovative dielectric and magnetic materials for high-density energy storage, switching devices, and non-linear transmission lines are also of fundamental interest.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F		10,991	56,548
Air Force	Materials	Tools for PMC Certification	Objective: enhance modeling tools & address AF airworthiness, sustainment, & SLEP for PMCs. Tasks: 1-modeling bonded assemblies capturing effects of processing of joints & damage/adhesive fracture, and 2-efficient discrete damage modeling for DaDT of PMCs at subcomponent/component level.	Increase Warfighter Capability	Materials and Design	3600	02	0602102F		-	1,640
Air Force	University Research Initiative	URI - Aerospace Materials for Extreme Environments	MURI, DURIP, and PECASE efforts executed under the Aerospace Materials for Extreme Environments program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F		3,672	11,625
Air Force	University Research Initiative	URI - Dynamic Materials and Interactions	MURI, DURIP, and PECASE efforts executed under the Dynamic Materials and Interactions program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F		600	600
Air Force	University Research Initiative	URI - GHz-THz Electronics and Materials	MURI, DURIP, and PECASE efforts executed under the GHz-THz Electronics and Materials	Increase Warfighter Capability	Materials and Design	3600	01	0601103F		2,345	7,946
Air Force	Aerospace Propulsion	Aircraft Thermal Systems	Technologies to improve thermal acquisition, transport and rejection	Increase Warfighter Capability	Platform Thermal Management	3600	02	0602203F		9,389	27,144
Air Force	Aerospace Propulsion and Power Technology	Aircraft Thermal Systems	Technologies to improve thermal acquisition, transport and rejection	Increase Warfighter Capability	Platform Thermal Management	3600	03	0603216F		19,147	42,650
Air	Aerospace	Integrated	Develop an integrated suite of efficient,	Increase	Platform	3600	02	0602203F		632	3,951

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Force	Propulsion	Vehicle Energy Tech (INVENT)	mission adaptive, robust electrical and thermal management systems to reduce aircraft energy demand	Warfighter Capability	Thermal Management						
Air Force	Aerospace Propulsion and Power Technology	Megawatt Aircraft Power and Thermal	Integrating new developments in Power and Thermal components to demonstrate advanced architectures to enable high powered mission systems for future Air Superiority platforms while maintaining energy efficiency. Technology maturation in advanced power and thermal architecture, modeling and simulation, and integration.	Increase Warfighter Capability	Platform Thermal Management	3600	03	0603216F		266	47,676
Air Force	Aerospace Propulsion	Megawatt Aircraft Power and Thermal	Developing flexible and adaptive Power and Thermal components that allow for synergetic architectures that leverage advanced engine capabilities and energy storage.	Increase Warfighter Capability	Platform Thermal Management	3600	02	0602203F		6,081	57,587
Air Force	Aerospace Propulsion and Power Technology	Megawatt Aircraft Power and Thermal	Integrating new developments in Power and Thermal components to demonstrate advanced architectures to enable high powered mission systems for future Air Superiority platforms while maintaining energy efficiency. Technology maturation in advanced power and thermal architecture, modeling and simulation, and integration.	Increase Warfighter Capability	Platform Thermal Management	3600	03	0603216F		-	1,228
Air Force	University Research Initiative	URI - Low Density Materials	MURI, DURIP, and PECASE efforts executed under the Low Density Materials program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F		1,162	1,588
Air Force	University Research Initiative	URI - Mechanics of Multifunctional Materials + Microsystems	MURI, DURIP, and PECASE efforts executed under the Mechanics of Multifunctional Materials + Microsystems program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F		533	533
Air Force	Aerospace Propulsion	Computational Engineering	Technologies, tools, and techniques for the system-level modeling of aircraft power and thermal management	Increase Warfighter Capability	M&S, Studies, and Wargames	3600	02	0602203F		3,833	16,055

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Defense Research Sciences	Flow Interactions and Control	The Flow Interactions and Control portfolio supports basic research into the dynamics and control of aerodynamic shear flows, including the interactions of these flows with rigid and flexible surfaces. The portfolio is interested in aerodynamic interactions arising in both internal and external flows and extending over a wide range of Reynolds numbers. The portfolio seeks to advance fundamental understanding of complex, time-dependent flow interactions by integrating theoretical/analytical, numerical, and experimental approaches. The focus on the understanding of the fundamental flow physics is motivated by an interest in developing physically-based predictive models and innovative control concepts for these flows. Research in this portfolio is motivated, in part, by the unique fluid-structure interactions that are found in nature, in vortex and shear layer flows, and on novel aerodynamic configurations.	Increase Warfighter Capability	Platform Upgrades Air	3600	01	0601102F		5,324	27,393
Air Force	Aerospace Vehicle Technologies	Legacy Fleet Energy Efficiency	Develops fuel burn reduction technologies for the legacy and future fleets	Enhance Mission Effectiveness	Platform Upgrades Air	3600	02	0602201F		576	1,111
Air Force	Aerospace Technology Development /Demonstration	Legacy Fleet Energy Efficiency	Demonstrate improved alloys, process and life prediction methods for engine disks	Enhance Mission Effectiveness	Platform Upgrades Air	3600	03	0603211F		722	722
Air Force	University Research Initiative	URI - Organic Materials Chemistry	MURI, DURIP, and PECASE efforts executed under the Organic Materials Chemistry program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F		2,602	3,741
Air Force	University Research Initiative	URI - Plasma and Electro-Energetic Physics	MURI, DURIP, and PECASE efforts executed under the Plasma and Electro-Energetic Physics program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F		5,523	13,155
Air Force	University Research Initiative	URI - Flow Interactions and Control	MURI, DURIP, and PECASE efforts executed under the Flow Interactions and Control program	Increase Warfighter Capability	Platform Upgrades Air	3600	01	0601103F		749	1,388
Air Force	SAF/IEN Funding	SAF/IEN Strategic Priorities	Develop policy and framework to support OE	Increase Warfighter Capability	Policy and Oversight	3400	04	0905015F		3,545	13,158

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Defense Research Sciences	Dynamic Data Driven Applications Systems	The DDDAS concept entails the ability to dynamically incorporate additional data into an executing application, and in reverse, the ability of an application to dynamically steer the measurement (instrumentation and control) components of the application system. DDDAS is a key concept for improving modeling of systems under dynamic conditions, more effective management of instrumentation systems, and is a key concept in building and controlling dynamic and heterogeneous resources, including, sensor networks, networks of embedded controllers, and other networked resources.	Increase Warfighter Capability	Power Controls and Distribution	3600	01	0601102F		7,955	40,931
Air Force	Aerospace Propulsion	Electrical Power Systems	Technologies for robust, reliable, efficient power management and distribution	Increase Warfighter Capability	Power Controls and Distribution	3600	02	0602203F		7,009	30,730
Air Force	Aero Prop and Power Technology	Electrical Power Systems	Technologies for robust, reliable, efficient power management and distribution	Increase Warfighter Capability	Power Controls and Distribution	3600	03	0603216F		1,268	7,639
Air Force	Aerospace Propulsion	Electro-Mechanical Power Systems	Technologies to improve the size, weight, and energy efficiency of electro-mechanical energy transfer processes	Increase Warfighter Capability	Power Controls and Distribution	3600	02	0602203F		4,985	19,098
Air Force	Aero Prop. and Power Technology	Electro-Mechanical Power Systems	Technologies to improve the size, weight, and energy efficiency of electro-mechanical energy transfer processes	Increase Warfighter Capability	Power Controls and Distribution	3600	03	0603216F		3,172	4,556
Air Force	Aerospace Propulsion	UAS Power and Control Product Area	Advanced power and control technologies for expanded and enhanced UAS capabilities	Increase Warfighter Capability	Power Controls and Distribution	3600	02	0602203F		4,605	22,627
Air Force	University Research Initiative	URI - Dynamic Data Driven Applications Systems	MURI, DURIP, and PECASE efforts executed under the Dynamic Data Driven Applications Systems	Increase Warfighter Capability	Power Controls and Distribution	3600	01	0601103F		764	1,600
Air Force	Aerospace Propulsion and Power Technology	Air Dominance Adaptive Propulsion Technology (ADAPT)	Design, fabricate, assemble, and test innovative turbine engine technologies that address future Air Superiority capability needs that provide increased thrust, decreased weight, improved fuel consumption, and improved affordability. For 6.3 activities, this program will leverage existing test assets to conduct key core and rig tests in order to advance adaptive engine technologies in the engine core.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	03	0603216F		6,145	55,472

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	Aerospace Propulsion	Air Dominance Adaptive Propulsion Technology (ADAPT)	Design, fabricate, assemble, and test (DFAT) innovative turbine engine technologies that address future Air Superiority capability needs that provide increased thrust, decreased weight, improved fuel consumption, and improved affordability. For 6.2 activities, provide additional adaptive engine technologies by analyzing variable core technology and testing advanced materials systems.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	02	0602203F		8,708	73,318
Air Force	Aerospace Propulsion and Power Technology	Air Dominance Adaptive Propulsion Technology (ADAPT)	DFAT innovative turbine engine technologies that address future Air Superiority capability needs that provide increased thrust, decreased weight, improved fuel consumption, and improved affordability. For 6.3 activities, leverage existing test assets to conduct key core and rig tests in order to advance adaptive engine technologies in the engine core.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	03	0603216F		11,379	42,545
Air Force	Aerospace Propulsion	Air Dominance Adaptive Propulsion Technology (ADAPT)	Design, fabricate, assemble, and test innovative turbine engine technologies that address future Air Superiority capability needs that provide increased thrust, decreased weight, improved fuel consumption, and improved affordability. For 6.2 activities, provide additional adaptive engine technologies by analyzing variable core technology and testing advanced materials systems.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	02	0602203F		1,918	12,588
Air Force	Aerospace Propulsion and Power Technology	Efficient Medium Scale Propulsion EMSP	Address propulsion technologies for improved fuel burn and reduced cost of ownership for future subsonic turbines for Group 5 UAS in ISR platforms. Goal of Phase I is to use a common commercial core engine, in the 5,000 to 1	Increase Warfighter Capability	Propulsion Upgrades Air	3600	03	0603216F		3,626	19,449
Air Force	Aerospace Propulsion	Efficient Medium Scale Propulsion (EMSP)	Address propulsion technologies for improved fuel burn and reduced cost of ownership for future subsonic turbines for Group 5 UAS in ISR platforms. The goal of the program is to use a common commercial core engine, in the 5,000 to 15,000 lb thrust range, and increase the platform power, demand power and thermal management capability. Also, development costs will be reduced.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	02	0602203F		2,459	9,717

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
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	Increase Warfighter Capability	Propulsion Upgrades Air	3600	02	0602203F		2,372	8,632
Air Force	Aerospace Propulsion	ITEMS	Suite of technologies designed to improve the thermal management of air-breathing propulsion systems.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	02	0602203F		1,909	11,157
Air Force	Defense Research Sciences	Molecular Dynamics and Theoretical Chemistry	This program seeks a molecular-level description of reaction mechanisms and energy transfer processes related to the efficient storage and utilization of energy. The program supports cutting-edge experimental and joint theory-experiment studies that address key, fundamental questions in these areas. There are four major focus areas in the program: Catalytic Reactivity and Mechanisms; Novel Energetic Material Concepts; Dynamics of Energy Transfer and Transport; and Chemistry in Extreme Environments.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	01	0601102F		12,006	61,772
Air Force	University Research Initiative	URI - Molecular Dynamics and Theoretical Chemistry	MURI, DURIP, and PECASE efforts executed under the Molecular Dynamics and Theoretical Chemistry program	Increase Warfighter Capability	Propulsion Upgrades Air	3600	01	0601103F		2,200	6,041
Air Force	Aerospace Propulsion	Adaptive Engine Transition Program (AETP)	Mature adaptive engine technologies to TRL 6+ for future integration and flight, while significantly improving fuel consumption. Note: 9 of 10 critical technology elements (CTEs) are scheduled to hit TRL 6; 1 CTE is scheduled to hit TRL 7. **Many of the key component technologies, flow paths and design parameters are either ITAR controlled or classified.	Increase Warfighter Capability	Propulsion Upgrades Air	3600	04	0604858F		285,057	2,662,121
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	Enhance Mission Effectiveness	Current Operations Tools	3400	02	0401840F		35	183

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Air Force	KC-135	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.	Enhance Mission Effectiveness	Propulsion Upgrades Air	3400	02	0401218F		428,633	1,972,656
Air Force	Human Effectiveness Applied Research	Learning Management Technology for Distributed Mission Operations and Live, Virtual and Constructive Operations	Develop and demonstrate interactive toolset for live virtual training	Enhance Mission Effectiveness	Training and Education	3600	03	0603456F		3,815	24,946
Air Force	Materials	Composites Certification	Development, maturation & integration of processing, performance & lifing tools for advanced composite, hybrid & multifunctional materials to support transition & certification Address cradle-to-grave certification Enable transition/certification	Increase Warfighter Capability	Materials and Design	3600	03	0603112F			1,800
								Total Air Force OE		973,057	5,909,217

Table 9. Army FY 2017 Operational Energy Initiatives (Dollars in Thousands)

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Army	Abrams Tank Improvement Program	Improved Abrams	More efficient Abrams - Research & Development effort to improve Abrams fuel efficiency by 21%.	Enhance Mission Effectiveness	Platform Upgrades Land	2040	07	0203735A		106	238
Army	Abrams Upgrade Program	Advanced Reliability & Costs Savings (ARCS)	Advanced Reliability & Cost Savings (ARCS) Hardware	Enhance Mission Effectiveness	Propulsion Upgrades Land	2033	01	0211702A		-	2,930
Army	Abrams Upgrade Program	Improved Abrams	Auxiliary Power Unit	Enhance Mission Effectiveness	Propulsion Upgrades Land	2033	01	0211702A		926	13,500
Army	Advanced Electrical Energy Concepts AD	Improved Power Distribution Illumination Systems Electrical (IPDISE)	More efficient power distribution	Enhance Mission Effectiveness	Contingency Basing	2040	04	0603804A		500	2,500
Army	Advanced Electrical Energy Concepts AD	Joint Operational Energy Initiative (JOEI)	Holistic approach to the evaluation of Operational Energy related impacts, systems and improvements	Enhance Mission Effectiveness	M&S, Studies, and Wargames	2040	04	0603804A		1,000	3,000
Army	AH-64 Apache Block IIIA REMAN	Apache Simulator	Simulator for the Apache Helicopter	Enhance Mission Effectiveness	Training and Education	2031	01	0210100A		24,130	100,370
Army	Army Field Feeding Equipment	Battlefield Kitchen	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Increase Warfighter Capability	Materials and Design	2040	05	0604713A		1,295	6,444
Army	Army Field Feeding Programs	Battlefield Kitchen	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Increase Warfighter Capability	Materials and Design	2040	04	0603747A		1,948	1,948
Army	Aviation Combined Arms Tactical Trainer (AVCATT)	Aviation Combined Arms Tactical Trainer (AVCATT)	Simulators for aviation asset collective training	Enhance Mission Effectiveness	Training and Education	2040	05	0604780A		2,769	23,282

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Army	Aviation Combined Arms Tactical Trainer (AVCATT)	Aviation Combined Arms Tactical Trainer (AVCATT)	Simulators for aviation asset collective training	Enhance Mission Effectiveness	Training and Education	2035	03	0219900A		40,000	159,331
Army	Bradley Improve Program	Improved Bradley	More efficient Bradley - Research and Development effort to improve Bradley fuel efficiency by 3%	Enhance Mission Effectiveness	Propulsion Upgrades Land	2040	07	0203735A		100	200
Army	Bradley Program (MOD)	Improved Bradley	Increases mobility with extended life track, and improved shocks, road arms and torsion bars	Enhance Mission Effectiveness	Platform Upgrades Land	2033	01	0211702A		48,600	327,300
Army	Bradley Program (MOD)	Improved Bradley	More efficient Bradley - The Bradley improved engine and transmission generate an overall fuel reduction of 3%	Increase Warfighter Capability	Propulsion Upgrades Land	2033	01	0211702A		19,200	168,200
Army	CH-47 Helicopter	Chinook Transportable Flight Proficiency Simulator (TFPS)	Chinook Transportable Flight Proficiency Simulator saves (TFPS)	Enhance Mission Effectiveness	Training and Education	2031	01	0210104A		6,500	7,960
Army	Chinook Product Improvement Program	Chinook Transportable Flight Proficiency Simulator (TFPS)	Chinook Transportable Flight Proficiency Simulator saves (TFPS)	Enhance Mission Effectiveness	Training and Education	2040	07	0210104A		-	36,740
Army	Combat Service Support Systems - AD	Force Provider	Base Camp Integration Lab (BCIL), Fort Devens / Net Zero / Zero Footprint	Enhance Mission Effectiveness	Contingency Basing	2040	04	0603804A		4,163	19,121
Army	Combat Service Support Systems - ED	Force Provider	Base Camp Integration Lab (BCIL) Fort, Devens / Net Zero / Zero Footprint	Enhance Mission Effectiveness	Contingency Basing	2040	05	0604804A		2,279	19,677
Army	Contingency Basing Infrastructure (CBI)	Contingency Basing Infrastructure (CBI)	Optimize recommendations for materiel used to establish, maintain, and operate contingency basing	Enhance Mission Effectiveness	M&S, Studies, and Wargames	2040	05	0604804A		3,470	16,723
Army	Distribution Systems,	Early Entry Fluid Distribution	More efficient fuel/non-potable water distribution in the battlespace	Reduce Logistics	Fuel Infrastructure	2035	03	0216300A		626	46,123

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
	Petroleum and Water	System (E2FDS)		Risks to Mission							
Army	Distribution Systems, Petroleum and Water	Expeditionary Water Packaging System (EWPS)	EWPS provides localized production of bottle water. Reduced reliance on shipping water into theater	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A		2,995	6,111
Army	Distribution Systems, Petroleum and Water	Modular Fuel System (MFS)	More efficient fuel distribution in the battlespace	Enhance Mission Effectiveness	Fuel Infrastructure	2035	03	0216300A		88,941	141,333
Army	Engine Driven Gen ED	Improved Power Distribution Illumination Systems Electrical (IPDISE)	More efficient power distribution	Enhance Mission Effectiveness	Contingency Basing	2040	05	0604804A		4,300	26,100
Army	Engine Driven Gen ED	Large Advanced Mobile Power Sources (LAMPS)	Large Advanced Mobile Power Sources (LAMPS)	Enhance Mission Effectiveness	Contingency Basing	2040	05	0604804A		2,300	2,300
Army	Engine Driven Gen ED	Small Tactical Electrical Power (STEP)	Small Tactical Electrical Power (STEP)	Increase Warfighter Capability	Contingency Basing	2040	05	0604804A		-	13,800
Army	Field Feeding Equipment	Battlefield Kitchen	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Increase Warfighter Capability	Materials and Design	2035	03	0216300A		-	19,636
Army	Force Provider	Force Provider	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%.	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A		53,800	53,800
Army	Generators and Associated Equipment	Advanced Mobile Medium Power Sources (AMMPS) Generator Sets	Purchase of the improved medium generator sets using 21% less fuel	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A		92,335	402,277
Army	Generators and Associated Equipment	Improved Power Distribution Illumination Systems	More efficient power distribution	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A		4,350	38,765

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
		Electrical (IPDISE)									
Army	Generators and Associated Equipment	Large Advanced Mobile Power Sources (LAMPS)	Large Advanced Mobile Power Sources (LAMPS)	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A		15,328	55,467
Army	Generators and Associated Equipment	Small Tactical Electrical Power (STEP)	Small Tactical Electric Power (STEP)	Increase Warfighter Capability	Contingency Basing	2035	03	0216300A		1,353	33,576
Army	Ground Soldier System	Nett Warrior	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A		3,458	25,021
Army	Heaters and ECUs	Improved Environmental Control Unit (IECU)	Heaters and Improved Environmental Control Unit (IECU) family	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A		18,601	68,404
Army	Improved Environmental Control Unit (IECU) - ED	Improved Environmental Control Unit (IECU)	Heaters and Improved Environmental Control Unit (IECU) family	Enhance Mission Effectiveness	Contingency Basing	2040	05	0604804A		1,210	11,997
Army	Improved Turbine Engine Program (ITEP)	Improved Aircraft Engine	More efficient helicopter engine. The Army expects 13% to 25% fuel reduction from current Blackhawk/Apache engines. Flies at higher altitudes, in hotter temperatures and increased range.	Increase Warfighter Capability	Propulsion Upgrades Air	2040	07	0607139A		116,100	1,008,500
Army	Integrated Soldier Power Data System - Core (ISPDS-C)	Integrated Soldier Power Data System - Core (ISPDS-C)	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2040	05	0604827A		-	12,557
Army	Joint Light Tactical Vehicle	Joint Light Tactical Vehicle (JLTV)	More efficient light vehicle - ~30% improvement in stationary fuel consumption over the baseline HMMWV	Enhance Mission Effectiveness	Platform Upgrades Land	2040	05	0605812A		-	188
Army	Joint Light Tactical Vehicle	Joint Light Tactical Vehicle (JLTV)	More efficient light vehicle - ~30% improvement in stationary fuel consumption over the baseline HMMWV	Enhance Mission Effectiveness	Platform Upgrades Land	2035	01	0216300A		98,454	684,434

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Army	M1 Abrams Tank MOD	Improved Abrams	More efficient Abrams - The Abrams Auxiliary Power Unit (APU) is expected to reduce combat day mission fuel consumption by 8%.	Enhance Mission Effectiveness	Platform Upgrades Land	2033	01	0211702A		4,250	7,750
Army	M1 Abrams Tank MOD	Advanced Reliability & Costs Savings (ARCS)	Advanced Reliability & Cost Savings (ARCS) for the AGT-1500 Turbine engine	Enhance Mission Effectiveness	Propulsion Upgrades Land	2033	01	0211702A		3,969	3,969
Army	Mobile Soldier Power	Platoon Power Generation (PPG)	Platoon Power Generation	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A		-	10,573
Army	Mobile Soldier Power	Small Unit Power Increment 1	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A		22,014	22,014
Army	Mobile Soldier Power	Integrated Soldier Power/Data System - Core (ISPDS-C)	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A		-	60,278
Army	Mobile Soldier Power	Universal Battery Charger (UBC)	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A		-	29,743
Army	Modification Of In-svc Equipment	Force Provider	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.	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A		16,444	23,761
Army	Soldier Power	Soldier Power	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2040	05	0604827A		8,999	8,999
Army	Soldier Power	Platoon Power Generation (PPG)	Platoon Power Generation	Enhance Mission Effectiveness	Individual/Warfighter Power	2040	05	0604827A		2,202	18,241
Army	Soldier Power Generator	Squad Power Manager (SPM)	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2040	05	0604827A		-	982
Army	Stryker (MOD)	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network	Enhance Mission Effectiveness	Propulsion Upgrades Land	2033	01	0202123A		-	896,500

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Army	Stryker Improvement	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network.	Enhance Mission Effectiveness	Propulsion Upgrades Land	2040	07	0202123A		54,400	80,800
Army	Stryker Upgrade	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network	Enhance Mission Effectiveness	Propulsion Upgrades Land	2033	01	0202123A		418,600	418,600
Army	UH-60 Black Hawk (MYP)	Black Hawk Aircrew Simulators	The Blackhawk simulator saves fuel and enhances safety	Enhance Mission Effectiveness	Training and Education	2031	01	0210101A		-	11,329
Army	UH-60 Black Hawk A and L Models	Black Hawk Aircrew Simulators	The Blackhawk simulator saves fuel and enhances safety	Enhance Mission Effectiveness	Training and Education	2031	01	0210101A		-	63,104
Army	Universal Battery Charger (UBC)	Universal Battery Charger (UBC)	Reduces Soldier Load, improved battery output, reduced weight, and ability to recharge them from alternative energy sources	Enhance Mission Effectiveness	Individual/Warfighter Power	2040	05	0604827A		-	6,085
Army	Water and Petroleum Distribution - AD	Early Entry Fluid Distribution System (E2FDS)	More efficient fuel/non-potable water distribution in the battlespace	Reduce Logistics Risks to Mission	Fuel Infrastructure	2040	04	0603804A		155	3,140
Army	Water and Petroleum Distribution - ED	Early Entry Fluid Distribution System (E2FDS)	More efficient fuel/non-potable water distribution in the battlespace	Reduce Logistics Risks to Mission	Fuel Infrastructure	2040	05	0604804A		1,954	10,961
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	Increase Warfighter Capability	Propulsion Upgrades Land	2040	01	0601101A		1,300	6,330
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.	Increase Warfighter Capability	Propulsion Upgrades Land	2040	01	0601102A		4,164	18,532
Army	Defense Research Sciences	Research In Vehicle Mobility 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.	Increase Warfighter Capability	Propulsion Upgrades Land	2040	01	0601102A		691	3,718

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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.	Increase Warfighter Capability	Individual/Warfighter Power	2040	01	0601102A		4,108	15,827
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.	Increase Warfighter Capability	Individual/Warfighter Power	2040	01	0601102A		593	593
Army	Defense Research Sciences	Fundamentals for Alternative Energy Applied Physics Research 08	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.	Increase Warfighter Capability	Individual/Warfighter Power	2040	01	0601102A		-	6,033
Army	Defense Research Sciences	Electrochemistry and Energy Conversion 52	Extramural basic research in electrochemistry and energy conversion, power generation, energy storage, and power management components and software.	Increase Warfighter Capability	Individual/Warfighter Power	2040	01	0601102A		6,504	22,611
Army	Aviation Technology	Advanced Concept Engine Components 58	Applied research in high efficiency engine component technology for manned and unmanned rotary wing aircraft.	Increase Warfighter Capability	Propulsion Upgrades Air	2040	02	0602211A		2,993	17,129
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.	Increase Warfighter Capability	Propulsion Upgrades Air	2040	02	0602211A		3,371	19,008
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.	Increase Warfighter Capability	Propulsion Upgrades Air	2040	02	0602211A		2,611	10,431
Army	Combat Vehicle and Automotive Technology	Advanced Combat Transmission STO 01EV	Ground vehicle applied research in ground vehicle transmission for combat vehicles	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		1,443	3,864

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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	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		5,235	21,681
Army	Combat Vehicle and Automotive Technology	Next Generation Combat Engine STO 01CV	Ground vehicle applied research in a high power density low heat rejection, fuel efficient engine technology.	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		912	912
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	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		3,237	21,112
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	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		992	992
Army	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research STO 88V	Ground vehicle applied research in auxiliary power unit technology.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		655	1,352
Army	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research 88I	Ground vehicle applied research in auxiliary power unit technology.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		597	1,861
Army	Combat Vehicle and Automotive Technology	High Voltage Power Generation Research STO 89SV	Ground vehicle applied research in high voltage power generation.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		1,242	2,064
Army	Combat Vehicle and Automotive Technology	Advanced Combat Transmission STO 87IV	Ground vehicle applied research in ground vehicle transmission for combat vehicles	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		1,355	2,805

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Army	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research 88	Ground vehicle applied research in auxiliary power unit technology.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		-	1,541
Army	Combat Vehicle and Automotive Technology	Pulse Power for Advanced Armors STO 96IV	Ground vehicle applied research in pulse power for future armor.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		3,442	3,442
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	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		1,312	4,090
Army	Combat Vehicle and Automotive Technology	High Voltage Power Generation Research 89	Ground vehicle applied research in high voltage power generation.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		-	1,619
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.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		-	1,889
Army	Combat Vehicle and Automotive Technology	Energy Storage Research STO 87SV	Ground vehicle applied research in energy storage	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		1,032	4,638
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.	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		2,817	8,782
Army	Combat Vehicle and Automotive Technology	Propulsion and Cabin Thermal Management Technologies STO 91V	Ground vehicle applied research in thermal management and propulsion	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		2,870	9,366
Army	Combat Vehicle and Automotive Technology	Propulsion and Cabin Thermal Management Technologies 91	Ground vehicle applied research in thermal management and propulsion	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		-	6,187

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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	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		228	7,276
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.	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		-	8,993
Army	Combat Vehicle and Automotive Technology	Vehicle Electrification Research 98	Ground vehicle applied research for vehicle electrification	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		-	2,500
Army	Combat Vehicle and Automotive Technology	Advanced Mobility Research 97	Ground vehicle applied research for mobility	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		-	4,341
Army	Combat Vehicle and Automotive Technology	Common Electronic Powertrain Controller 17	Ground vehicle applied research for electronic powertrain controller	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		400	400
Army	Combat Vehicle and Automotive Technology	Coating Binder for Lithium Ion Batteries 10	Ground vehicle applied research for lithium ion battery binder	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		500	500
Army	Combat Vehicle and Automotive Technology	Tactical Vehicle Electrification Kit 16	Ground vehicle applied research for vehicle electrification	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		500	500
Army	Combat Vehicle and Automotive Technology	Fuel Efficient Military Tire 09	Ground vehicle applied research for more fuel efficient tire	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		600	600
Army	Combat Vehicle and Automotive Technology	Militarized Fuel Cell Vehicle 14	Ground vehicle applied research in militarized fuel cell vehicle	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		1,100	1,100
Army	Combat Vehicle and Automotive Technology	Energy Informed Operations 18	applied research for tactical microgrids	Increase Warfighter Capability	Contingency Basing	2040	02	0602601A		2,000	2,000

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Army	Combat Vehicle and Automotive Technology	Autonomy-Enabled Improvements in Operational Energy 15	Ground vehicle applied research exploring autonomy for reduced fuel consumption	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602601A		2,900	2,900
Army	Combat Vehicle and Automotive Technology	Next Generation Combat Engine 12	Ground vehicle applied research for next gen combat engine	Increase Warfighter Capability	Propulsion Upgrades Land	2040	02	0602601A		7,600	7,600
Army	Electronics and Electronic Devices	TPV materials and device characterization 91H	Applied research for thermophovoltaic materials	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		100	100
Army	Electronics and Electronic Devices	Enhanced Thermophovoltaic (TPV) cell efficiency 91G	Applied research for improved thermophovoltaic cell efficiency	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		700	700
Army	Electronics and Electronic Devices	Components for Small Power to Enable Reliable payload agnostic UAS (\$780 K external, \$100K in-house) 91D	applied research in components for reduced power consumption in use payloads	Increase Warfighter Capability	Platform Upgrades Air	2040	02	0602705A		880	880
Army	Electronics and Electronic Devices	Adv Platform Concepts for Payload Agnostic UAS Cap with Low Power Demand (\$840K ext; \$90k in-house) 91A	applied research in components for reduced power consumption in usa payloads	Increase Warfighter Capability	Platform Upgrades Air	2040	02	0602705A		930	930
Army	Electronics and Electronic Devices	Silicon Carbide Research-ARL 86A	Applied research for silicon carbide electronic devices	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602705A		10,000	10,000

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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.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602705A		2,025	9,361
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	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602705A		1,449	2,949
Army	Electronics and Electronic Devices	Electronic Components and Materials Research 09V	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.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602705A		1,060	3,060
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.	Increase Warfighter Capability	Platform Upgrades Land	2040	02	0602705A		2,278	13,762
Army	Electronics and Electronic Devices	Energy Informed Operations STO 07TV	applied research for tactical power generation technology	Increase Warfighter Capability	Contingency Basing	2040	02	0602705A		1,430	1,430
Army	Electronics and Electronic Devices	ExMC STO-D - Energy Informed Operations 09	applied research for tactical power generation technology	Increase Warfighter Capability	Contingency Basing	2040	02	0602705A		-	1,430
Army	Electronics and Electronic Devices	Advanced Integrated Soldier Power STO 06V	Soldier transportable power source applied research	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		4,034	10,589
Army	Electronics and Electronic Devices	Expeditionary Soldier & Small Unit Power Technologies 06	Soldier transportable power source applied research	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		-	6,039

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Army	Electronics and Electronic Devices	Energy Informed Operations Technologies 07T	applied research for tactical power generation technology	Increase Warfighter Capability	Contingency Basing	2040	02	0602705A		2,932	20,790
Army	Electronics and Electronic Devices	Logistic Fuel Reform & Processing 72	Applied research in reforming logistics fuel for fuel cell hydrogen	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		1,202	4,494
Army	Electronics and Electronic Devices	Efficient Compact Portable Power 68	Applied research in compact portable power sources	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		874	4,540
Army	Electronics and Electronic Devices	Energy Harvesting Technologies 83	Applied research in soldier energy scavenging technology	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		2,524	14,571
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.	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		1,152	1,152
Army	Electronics and Electronic Devices	High Density E-Chem Sources & Storage STO 71V	Applied research in higher energy density batteries and power sources	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		250	650
Army	Electronics and Electronic Devices	High Density E-Chem Sources & Storage 71	Applied research in higher energy density batteries and power sources	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A		1,385	7,866
Army	Warfighter Technology	Expeditionary Mobile Base Camp Technologies 04	Applied research for mobile base camps	Increase Warfighter Capability	Contingency Basing	2040	02	0602786A		-	3,240
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	Increase Warfighter Capability	Individual/Warfighter Power	2040	03	0603001A		2,104	13,890

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Army	Aviation Advanced Technology	Next Generation Rotorcraft Transmission 15	Matures and demonstrates components, subsystems and systems for rotorcraft transmissions (both manned and unmanned)	Increase Warfighter Capability	Propulsion Upgrades Air	2040	03	0603003A		974	12,038
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.	Increase Warfighter Capability	Propulsion Upgrades Air	2040	03	0603003A		4,757	20,910
Army	Weapons and Munitions Advanced Technology	Power Mgmt Ruggedization 08	Matures and demonstrates power management technologies for future directed energy weapons technology.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603004A		-	9,158
Army	Weapons and Munitions Advanced Technology	Power Mgmt Integration 06A	Matures and demonstrates power management technologies for future directed energy weapons technology.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603004A		-	8,284
Army	Weapons and Munitions Advanced Technology	Thermal Mgmt Integration 05A	Matures and demonstrates thermal management technologies for future directed energy weapons technology.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603004A		-	9,657
Army	Weapons and Munitions Advanced Technology	Power Mgmt Ruggedization STO 08V	Matures and demonstrates power management technologies for future directed energy weapons technology.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603004A		17,179	17,179
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.	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		195	399
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.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		570	570

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Army	Combat Vehicle and Automotive Advanced Technology	Energy Storage Systems Development STO 57IV	Ground vehicle Energy Storage Systems advanced technology Development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		959	2,092
Army	Combat Vehicle and Automotive Advanced Technology	Water & Fuel Distribution 66	Advanced technology demonstration of next generation vehicle electrification Advanced technology demonstration of water and fuel distribution	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		1,443	2,943
Army	Combat Vehicle and Automotive Advanced Technology	Energy Storage Systems Development STO 57JV	Ground vehicle Energy Storage Systems advanced technology Development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		1,058	3,258
Army	Combat Vehicle and Automotive Advanced Technology	Energy Storage Systems Development STO 57V	Ground vehicle Energy Storage Systems advanced technology Development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		917	3,835
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.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		3,887	3,887
Army	Combat Vehicle and Automotive Advanced Technology	High Performance Track Development 6II	Ground vehicle high performance track development	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		1,924	3,926
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.	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		2,283	5,839
Army	Combat Vehicle and Automotive Advanced Technology	Energy Storage Systems Development 57	Ground vehicle Energy Storage Systems advanced technology Development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		-	3,571

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Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electrification Development 69	Advanced technology demonstration of vehicle electrification	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		-	2,500
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.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		3,125	8,778
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.	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		-	5,848
Army	Combat Vehicle and Automotive Advanced Technology	Powertrain/Energy Storage/Survivability Demonstrator DTAZ	Advanced technology demonstration of combat vehicle powertrain and energy storage	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		5,003	12,463
Army	Combat Vehicle and Automotive Advanced Technology	Efficient Powertrain Technology Integration STO 55V	Ground vehicle Efficient Powertrain Technology Integration advanced technology development	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		4,811	14,604
Army	Combat Vehicle and Automotive Advanced Technology	Efficient Powertrain Technology Integration 55	Ground vehicle Efficient Powertrain Technology Integration advanced technology development	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		-	10,316
Army	Combat Vehicle and Automotive Advanced Technology	Powertrain/Energy Storage/Survivability Demonstrator STO DTA V	Advanced technology demonstration of combat vehicle powertrain and energy storage	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		7,512	21,535

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Army	Combat Vehicle and Automotive Advanced Technology	Hybrid / High Power Vehicle Evaluations STO 601V	Hybrid / High Power ground Vehicle technology Evaluations	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		353	353
Army	Combat Vehicle and Automotive Advanced Technology	Hybrid / High Power Vehicle Evaluations STO 60V	Hybrid / High Power ground Vehicle technology Evaluations	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603005A		1,045	2,392
Army	Combat Vehicle and Automotive Advanced Technology	Alternative Fuels and Petroleum, Oil & Lubricants STO 51TV	Ground vehicle alternative fuels and petroleum, oil & lubricants advanced technology development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		796	796
Army	Combat Vehicle and Automotive Advanced Technology	Alternative Fuels and Petroleum, Oil & Lubricants 51	Ground vehicle alternative fuels and petroleum, oil & lubricants advanced technology development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		264	8,658
Army	Combat Vehicle and Automotive Advanced Technology	Powertrain/Energy Storage/Survivability Demonstrator (OE) DOEZ	Ground vehicle advanced technology development demonstrator	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		-	17,302
Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electronics Integration Technologies STO 16V	Ground vehicle electronics integration advanced technology development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		577	577
Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electronics Architecture and Standards 15I	Ground vehicle electronics architecture and standards advanced development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		998	4,342
Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electronics Integration Technologies 16I	Ground vehicle electronics integration advanced technology development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		1,870	5,750

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electronics Integration Technologies 16	Ground vehicle electronics integration advanced technology development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		949	9,186
Army	Combat Vehicle and Automotive Advanced Technology	Vehicle Electronics Architecture and Standards 15	Ground vehicle electronics architecture and standards advanced development	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603005A		1,093	9,849
Army	Combating Terrorism, Technology Development	Advanced Combat Transmission DRLV	Advanced technology demonstration of next generation combat transmission	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603125A		1,254	3,522
Army	Combating Terrorism, Technology Development	Powertrain/Energy Storage/Survability Technology DRLZ	Advanced technology demonstration of combat vehicle powertrain and energy storage	Increase Warfighter Capability	Propulsion Upgrades Land	2040	03	0603125A		3,554	6,359
Army	Combating Terrorism, Technology Development	AVPTA AVP	Conducts Ground Vehicle Power Technology efforts with DoE	Increase Warfighter Capability	Platform Upgrades Land	2040	03	0603125A		5,047	26,841
								Total Army OE		1,375,134	5,905,741

Table 10. Marine Corps FY 2017 Operational Energy Initiatives (Dollars in Thousands)

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	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.	Enhance Mission Effectiveness	Individual/Warfighter Power	1106	01	0203761 M	-	-	2,518
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.	Enhance Mission Effectiveness	Individual/Warfighter Power	1106	01	0206624 M	1	1	5

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	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.	Increase Warfighter Capability	Individual/Warfighter Power	1319	01	0206624 M	5219	1494	9394
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.	Enhance Mission Effectiveness	Individual/Warfighter Power	1106	01	0804771 M	102	103	535

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	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.	Enhance Mission Effectiveness	Individual/Warfighter Power	1109	03	0502511 M	3	3180	10559
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.	Enhance Mission Effectiveness	Individual/Warfighter Power	1109	03	0206211 M	7746	11300	47792
Marine Corps	Advanced Technology Demo	Marine Corps Operational Energy: Energy Optimization and Logistic Burden Reduction	Advanced Technology Demonstration research to optimize energy usage and/or meet operational energy demand with renewable energy sources and reduce excess capacity or reduce logistic footprint/burden energy sources. Develop, optimize, integrate, and demonstrate at	Increase Warfighter Capability	Individual/Warfighter Power	1319	03	0603640 M	7,900	5,000	47,286

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
			least 15% fuel efficiency improvement over the existing MTRV.								
Marine Corps	Applied Research	Marine Corps Operational Energy: Energy Efficiency and Demand Reduction	Applied Research to increase energy efficiency in weapons systems, platforms, vehicles and equipment and extend tactical range/operational reach. Develop, optimize, integrate, and demonstrate at least 15% fuel efficiency improvement over the existing MTRV.	Increase Warfighter Capability	Individual/Warfighter Power	1319	02	0602131 M	2,650	2,450	15,047
Marine Corps	Combat Opns CTR (COC)	Combat Operations Center (COC)	The CMBT OPS Center provides the necessary infrastructure for a scalable transportable CMD and CNTL Capability.	Enhance Mission Effectiveness	Contingency Basing	1106	01	0206626 M	1489	-	1,489
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range fr 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Enhance Mission Effectiveness	Contingency Basing	1106	01	0206624 M	55	57	321

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range fr 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Enhance Mission Effectiveness	Contingency Basing	1109	06	0206315 M	-	-	1,253
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range fr 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Enhance Mission Effectiveness	Contingency Basing	1109	06	0502514 M	-	18	1,630
Marine Corps	Environmental Control Equipment	Improved Environmental Control Units	Family includes ECUs. Portfolio is horizontal/vertical configured MC Standard air conditioners. ECUs range fr 9,000 to 120,000 BTUs for 50/60/400HZ. EECU provides ~17% increased efficiency across the portfolio of systems.	Enhance Mission Effectiveness	Contingency Basing	1319	01	0206624 M	192	262	2,358
Marine Corps	Expeditionary Energy Office	Expeditionary Energy Office	A Director-level office within HQMC, E2O is responsible for advising the CMC and MROC on all energy and resource requirements, acquisitions, and programmatic decisions.	Increase Warfighter Capability	Individual/Warfighter Power	1106	04	0902498 M	3,429	3,464	15,664
Marine Corps	Expeditionary Energy Office	Expeditionary Energy Office	A Director-level office within HQMC, E2O is responsible for advising the CMC and MROC on all energy and resource requirements, acquisitions, and programmatic decisions.	Increase Warfighter Capability	Individual/Warfighter Power	1106	04	0902498 M	2,140	2,156	11,361
Marine Corps	LAV Obsolescence (OB)	LAV Obsolescence	Replace the obsolete Full-Up Powerpack with a smaller, more efficient off-the-shelf unit	Enhance Mission Effectiveness	Platform Upgrades Land	1109	02	0206211 M	-	-	39,283
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.	Increase Warfighter Capability	Contingency Basing	1319	07	0206623 M	170	130	1,095

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Marine Corps	MCWL/Futures Directorate (MCWL/FD)	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	Increase Warfighter Capability	Contingency Basing	1319	03	0603640 M	470	465	5,050
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.	Enhance Mission Effectiveness	Platform Upgrades Land	1106	01	0702808 M	1,984	1,448	3,032
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.	Increase Warfighter Capability	Platform Upgrades Land	1319	07	0206624 M	2,861	316	1,669
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.	Enhance Mission Effectiveness	Platform Upgrades Land	1109	05	0206315 M	1,212	3,408	28,468
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.	Enhance Mission Effectiveness	Contingency Basing	1109	06	0206315 M	738	3,413	42,780

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
			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.								
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 100 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.	Enhance Mission Effectiveness	Contingency Basing	1319	07	0206624 M	500	-	-

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	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.	Increase Warfighter Capability	Contingency Basing	1106	01	0206624 M	100	100	498
								Total Marine Corps OE	38,961	38,765	287,616

Table 11. Navy FY 2017 Operational Energy Initiatives (Dollars in Thousands)

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Integrated Condition Assessment System	Integrated Condition Assessment System	The Integrated Condition Assessment System is a combination of hardware and software that allows for remote monitoring of shipboard engineering systems. This data is used for condition based maintenance planning, trouble shooting, and input to the Energy Dashboard.	Enhance Mission Effectiveness	Metering and Monitoring	1810	01	0204228N		662	3,730
Navy	Amphib Energy Initiatives	LSD Stern Flap and Propeller Coatings	Stern flap includes a steel plate appendage welded to the transom that extends from the hull bottom surface to modify the flow field under the hull after-body resulting in reduced drage. Propeller Coatings reduce blades roughness and bio-fouling build-up to maximize propeller efficiency and reduce fuel consumption.	Enhance Mission Effectiveness	Platform Upgrades Sea	1804	01	0204411N		3,028	16,088
Navy	Amphib Solid State Lighting (SSL)	Amphib Solid State Lighting (SSL)	Replaces 50W and 110W incandescent globes fixtures and select lamp fluorescent bulbs with LEDs to reduce energy usage. Install also reduces electrical lighting load, maintenance actions, HAZMAT, and space needed for spare parts.	Enhance Mission Effectiveness	Platform Upgrades Sea	1810	01	0204411N		1,818	10,875
Navy	Amphibious Tactical Supt Units	Energy Supportability analysis	These funds are allocated for conducting an Energy Supportability analysis in support of the Energy Key Performance Parameter (KPP)	Enhance Mission Effectiveness	M&S, Studies, and Wargames	1319	07	0204413N		476	476
Navy	Ship Prepositioning and Surge	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.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	02	0408042N		-	7,704
Navy	Ship Prepositioning and Surge	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, auxiliary pre-stage refrigeration units and the implementation of intelligent HVAC on other ship classes.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	02	0408042N		672	10,605

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Ship Preliminary Design and Feasibility Studies	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 less energy through new equipment or technology.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	04	0408042N		1,631	9,338
Navy	Ship Preliminary Design and Feasibility Studies	Energy Initiative Studies and Development	Researching, identifying, and developing energy saving initiatives to the point where they can be directly applied to ship-based environments.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	04	0408042N		1,476	8,963
Navy	Ready Reserve Force	HVAC Efficiency Improvements	Energy Efficient HVAC Systems to include A/C System Replacement (Long Range Life) and upgrades to the cargo ventilation system	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	05	0408042N		1,400	6,870
Navy	Ship Preliminary Design and Feasibility Studies	E-Stream	E-STREAM, or Electric-Standard Tensioned Replenishment Alongside Method, reduces energy use during underway replenishments. The variable frequency driven electric motors with PLC controllers that replace the hydraulic winches and sliding block saves energy, improves replenishment speed and saves on maintenance costs.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	04	0408042N		6,155	17,422
Navy	Ship Preliminary Design and Feasibility Studies	Auditing, Modeling & Savings Analysis	Conduct shipboard energy audits to analyze energy usage onboard ships, facilitate and optimize energy reduction methods, and analyze the alternatives to reduce energy costs. This data will feed into the ENCON Calibrated Baseline Model for each ship class. Once calibrated through audit data input, the model serves as an accurate and flexible tool to generate baseline energy usage profiles for various missions, load-outs, area or operations, and operating conditions. Highlights in this effort include: shipboard measurement and verification protocol, class energy profile exercises, and retrocommissioning.	Enhance Mission Effectiveness	Metering and Monitoring	4557	04	0408042N		1,181	5,258

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Ship Preliminary Design and Feasibility Studies	HVAC&R Efficiency Improvement	Design and research of 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, auxiliary pre-stage refrigeration units and the implementation of intelligent HVAC on other ship classes.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	04	0408042N		652	3,954
Navy	Ship Prepositioning and Surge	Route Planning & Optimization	Implementing route planning programs, such as the Replenishment At Sea Planner (RASP), that 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.	Enhance Mission Effectiveness	Current Operations Tools	4557	02	0408042N		-	2,017
Navy	Ready Reserve Force	Lighting Upgrades	Installation of High Efficiency Lighting and motion detected lights for cargo holds	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	05	0408042N		250	2,390
Navy	Ship Prepositioning and Surge	Pump & Motor Efficiency Improvements	Implementing the use of 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.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	02	0408042N		900	9,248
Navy	Ship Preliminary Design and Feasibility Studies	Route Planning & Optimization	Developing route planning programs, such as the Replenishment At Sea Planner (RASP), that 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.	Enhance Mission Effectiveness	Current Operations Tools	4557	04	0408042N		816	3,326
Navy	Ship Prepositioning and Surge	Lighting Upgrades	Upgrade currently installed lighting with newer technologies to increase energy efficiency. Initiatives include using Light Emitting Diode (LED) technology, installing light switches and intelligent lighting technology such as motion and occupancy sensors.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	02	0408042N		250	2,848

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Ship Preliminary Design and Feasibility Studies	Hull Coatings	Testing and prototyping the application of commercially available hull coatings to better match hull coating to ship optempo. The goal is to prevent biofouling so that propulsive efficiency is maximized.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	04	0408042N		576	2,425
Navy	Ship Preliminary Design and Feasibility Studies	Improved Metering and Monitoring	Design of work packages for fuel meters and shore power meters. This fuel metering technology corrects for density, temperature and air entrapment. 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 will feed into an Energy Dashboard used to monitor real time energy usage, which will enable ship operators to make operational changes that decrease overall energy usage.	Enhance Mission Effectiveness	Metering and Monitoring	4557	04	0408042N		163	754
Navy	Ship Preliminary Design and Feasibility Studies	Policy Guidance & Development and Training & Incentive Program	Developing 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. Developing an incentive program to incentivize efficient ship operation and the generation of energy conservation initiatives.	Enhance Mission Effectiveness	Training and Education	4557	04	0408042N		200	650
Navy	Ready Reserve Force	Propulsion Systems	Includes upgrades to: Main Propulsion/Engine control systems; engine room konsberg/autronica monitoring system; CPP System; new fuel purifiers; plate coolers for LO cooling (overhaul)	Enhance Mission Effectiveness	Propulsion Upgrades Sea	4557	05	0408042N		2,100	4,490

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Ship Prepositioning and Surge	Improved Metering and Monitoring	Installation of fuel meters and shore power meters. This fuel metering technology corrects for density, temperature and air entrapment. 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 will feed into an Energy Dashboard that will be used to monitor real time energy usage, which will enable ship operators to make operational changes that decrease overall energy use.	Enhance Mission Effectiveness	Metering and Monitoring	4557	02	0408042N		-	590
Navy	Ship Prepositioning and Surge	Hull Coatings	Application of tested commercially available hull coatings to better match coating to ship optempo. The goal is to prevent biofouling so that propulsive efficiency is maximized.	Enhance Mission Effectiveness	Platform Upgrades Sea	4557	02	0408042N		-	-
Navy	Defense Research Sciences	Power and Energy Materials Research	Energy storage and power generation materials basic research	Increase Warfighter Capability	Materials and Design	1319	01	0601153N		6,652	41,852
Navy	Defense Research Sciences	NRL Base - Energy	Long term Basic and Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Alternative Power Sources	1319	01	0601153N		1,397	18,857
Navy	Defense Research Sciences	Energy Storage and Power Management	Advancing power and energy science through fundamental research in the areas of conductor and permanent magnet materials, energy conversion, combustion, and cyber physical system modeling.	Increase Warfighter Capability	Platform Upgrades Sea	1319	01	0601153N		1,925	12,045
Navy	Defense Research Sciences	Distribution/Control of Power Science	Fulfill the power and energy needs of the Navy's next-generation weapons and platforms by improving (1) Education, (2) Reliability of power electronic devices, (3) Power density of power systems, and (4) Power Electronics Manufacturing costs.	Increase Warfighter Capability	Platform Upgrades Sea	1319	01	0601153N		1,808	11,655

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Defense Research Sciences	Heat Transfer & Thermal Management Science	Advance thermal science and technology through fundamental studies of multi-phase heat transfer, fluid dynamics, and nanostructured materials to efficiently acquire, transport, and reject heat and enable higher power density electronic sys	Increase Warfighter Capability	Platform Thermal Management	1319	01	0601153N		1,358	8,743
Navy	DEFENSE RESEARCH SCIENCES	Sea Based Aviation Propulsion Basic Research	This Program provides long-term basic research that discovers new phenomena related power propulsion and thermal management, with the intent that they mature to provide transition opportunities for the associated applied research program. This Program also supports university research in these areas and the associated graduate student support to help build the number and quality of Scientists and Engineers with relevant skills to help further develop power and propulsion systems for future Sea Based Aviation platforms and weapon systems.	Increase Warfighter Capability	Propulsion Upgrades Air	1319	01	0601153N		926	8,330
Navy	DEFENSE RESEARCH SCIENCES	Naval Biosciences - Microbial and Biomolecular Fuel Cell	Microbial fuel cells (MFC) provide electricity harvested from specialized natural bacteria that use non-hazardous organic compounds as fuel, and then provide electrical current to an electrode. Can be used to sustainably power seafloor sensors/systems in place of batteries.	Increase Warfighter Capability	Mobile Fuel Assets	1319	01	0601153N		761	4,304
Navy	DEFENSE RESEARCH SCIENCES	Basic Catalysis	Basic research exploring chemical transformations via catalytic processes, including the production of hydrogen from precursor molecules.	Increase Warfighter Capability	Materials and Design	1319	01	0601153N		300	3,562
Navy	DEFENSE RESEARCH SCIENCES	Synthetic Biology for Sensing & Energy Production	Develop transformational approaches using living organisms to produce, fuels or other high-value compounds	Increase Warfighter Capability	Alternative Power Sources	1319	01	0601153N		423	2,423
Navy	DEFENSE RESEARCH SCIENCES	NRL Base - Energy	Long term Basic and Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Contingency Basing	1319	01	0601153N		-	1,140

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	FORCE PROTECTION APPLIED RESEARCH	Energy Efficiency & Alternative Energy Technologies	Applied research on unmanned vehicle fuel cell power systems, high temperature energy systems, photovoltaics, wave energy testing, and microgrid analyses.	Increase Warfighter Capability	Platform Upgrades Sea	1319	02	0602123N		13,294	78,631
Navy	FORCE PROTECTION APPLIED RESEARCH	Electric Ship Research & Development Consortium	ONR sponsors the Electric Ship Research and Development Consortium (ESRDC), composed of eight leading universities. The ESRDC is focused on afloat power systems, and leads efforts to address a national shortage of electric power engineers, and ensure U.S. superiority in electric systems.	Increase Warfighter Capability	Platform Upgrades Sea	1319	02	0602123N		9,010	52,656
Navy	FORCE PROTECTION APPLIED RESEARCH	Propulsion Task Force Energy (TFE)	This Program, in partnership with the Variable Cycle Advance Technology (VCAT) program, has the objective to develop variable geometry and adaptive cycle gas turbine engine technology for next generation air dominance aircraft. The benefits of these technologies are anticipated to be reduced fuel consumption and hence greater operational range and reduced logistics tail, mostly by reducing the demand for deployed fuel and tanker aircraft support.	Increase Warfighter Capability	Propulsion Upgrades Air	1319	02	0602123N		3,720	38,361
Navy	FORCE PROTECTION APPLIED RESEARCH	Sea Based Aviation Propulsion Applied Research	This Program provides medium-term, applied research to demonstrate advanced engine technologies applicable to engine components for naval aviation platforms in propulsion-related technology areas. The specific areas addressed in this program are: (1) Propulsion Cycles, Subsystems, and Engine-Airframe Integration (2) High Stage-Loading, Variable-Geometry, and Enhanced Durability Turbomachinery (3) Jet Noise Reduction for tactical aircraft (4) Hot Section Materials and Coatings, (5) Higher Power Density and Stability Combustion Systems, and (6) Small Propulsion Engine Technology for Autonomous Air Vehicles.	Increase Warfighter Capability	Propulsion Upgrades Air	1319	02	0602123N		3,772	18,201

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	FORCE PROTECTION APPLIED RESEARCH	NRL Base - Energy	Long term Basic and Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Alternative Power Sources	1319	02	0602123N		1,694	8,735
Navy	FORCE PROTECTION APPLIED RESEARCH	Next Generation Integrated Power System	Applied Research supporting activities linked with newly established Combat Power and Energy Systems (CPES) led by NAVSEA and PEO(Ships), including research on complex energy network controls in coordination with PMS320.	Increase Warfighter Capability	Platform Upgrades Sea	1319	02	0602123N		1,000	4,705
Navy	WARFIGHTER SUSTAINMENT APPLIED RESEARCH	Biocentric Technology (Energy)	Program focuses on microbes that produce electricity from organic matter found in sediment or wastewater, and is targeting two distinct naval applications: (1) Powering of undersea devices and sensors for environmental monitoring, and (2) shipboard desalination and wastewater degradation	Increase Warfighter Capability	Alternative Power Sources	1319	02	0602236N		1,226	6,678
Navy	WARFIGHTER SUSTAINMENT APPLIED RESEARCH	NRL Base - Energy	Long term Basic and Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Alternative Power Sources	1319	02	0602236N		552	2,852
Navy	OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	NRL Base - Energy	Long term Basic and Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Alternative Power Sources	1319	02	0602435N		-	3,932

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	UNDERSEA WARFARE APPLIED RESEARCH	Undersea Weaponry (USW) - Power & Energy	Applied research to develop component, subsystem and system technologies that are the critical building blocks for advanced high-energy-density and power-density propulsion systems, enabling increased endurance (days/weeks/months) and reliability in an air-independent environment. Approaches include modeling and simulation, fuel cells, engines, novel fuels/oxidizers and reactant storage/delivery systems.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	02	0602747N		1,322	6,122
Navy	UNDERSEA WARFARE APPLIED RESEARCH	Forward Deployed Energy & Communications Outposts (FDECO) - Energy	FDECO will prototype open, scalable and coordinated undersea energy, data and communications infrastructure for undersea vehicles and sensors. FDECO presents a scalable underwater replenishment network in the form of modularized, platform-independent outposts, "hotspots" for energy, secure communications, and data sharing between undersea platforms. FDECO energy (50% of total FDECO funding) is assigned to Energy portfolio. INP-FDECO starts in FY16	Increase Warfighter Capability	Mobile Fuel Assets	1319	02	0602747N		6,984	6,984
Navy	UNDERSEA WARFARE APPLIED RESEARCH	Large Displacement Unmanned Undersea Vehicle (LDUUV)	Develop and demonstrate TRL 6 scalable air-independent technology to significantly increase the endurance of UUVs to 70+ days to gain persistent access to areas denied to manned platforms, act as a force multiplier and decrease platform and personnel vulnerabilities due to the frequent energy section refresh required in current UUVs.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	02	0602747N		322	322
Navy	Future Naval Capabilities Applied Research	Torpedo Advanced Propulsion System (TAPS) (FNC)	Develop and demonstrate a prototype torpedo propulsion module (aft section) to evolve the current Mk-48 Advanced Capability Heavyweight Torpedo (ADCAP HWT) to a covert, extended-range weapon for Anti-Surface Warfare (ASuW), Anti-Submarine Warfare (ASW), or limited Precision Strike (PSTK) missions.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	02	0602750N		369	16,491

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Future Naval Capabilities Applied Research	Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation (FNC)	A package of advanced materials that will realize an improvement of 3X or more in engine life at higher operating temperatures.	Increase Warfighter Capability	Materials and Design	1319	02	0602750N		1,791	4,751
Navy	Future Naval Capabilities Applied Research	Air Independent Propulsion System (FNC)	Enable energy dense propulsion systems to support long endurance undersea vehicle missions.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	02	0602750N		1,181	1,181
Navy	Innovative Naval Prototypes(INP) Applied Res	Large Displacement Unmanned Undersea Vehicle (LDUUV)	Develop and demonstrate TRL 6 scalable air-independent technology to significantly increase the endurance of UUVs to 70+ days to gain persistent access to areas denied to manned platforms, act as a force multiplier and decrease platform and personnel vulnerabilities due to the frequent energy section refresh required in current UUVs.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	02	0602792N		1,500	18,500
Navy	Innovative Naval Prototypes(INP) Applied Res	Forward Deployed Energy & Communications Outpost (FDECO) - Energy	FDECO will prototype open, scalable and coordinated undersea energy, data and communications infrastructure for undersea vehicles and sensors. FDECO presents a scalable underwater replenishment network in the form of modularized, platform-independent outposts, "hotspots" for energy, secure communications, and data sharing between undersea platforms. FDECO energy (50% of total FDECO funding) is assigned to Energy portfolio. INP-FDECO starts in FY16	Increase Warfighter Capability	Mobile Fuel Assets	1319	02	0602792N		-	5,223

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	FORCE PROTECTI ON ADVANC ED TECHNOL OGY	Forward Deployed Energy & Communication s Outpost (FDECO) - Energy	FDECO will prototype open, scalable and coordinated undersea energy, data and communications infrastructure for undersea vehicles and sensors. FDECO presents a scalable underwater replenishment network in the form of modularized, platform-independent outposts, "hotspots" for energy, secure communications, and data sharing between undersea platforms. FDECO energy (50% of total FDECO funding) is assigned to Energy portfolio. INP-FDECO starts in FY16	Increase Warfighter Capability	Mobile Fuel Assets	1319	03	0603123N		1,616	1,616
Navy	Future Naval Capabilities Advanced Tech Dev	Torpedo Advanced Propulsion System (TAPS) (FNC)	Develop and demonstrate a prototype torpedo propulsion module (aft section) to evolve the current Mk-48 Advanced Capability Heavyweight Torpedo (ADCAP HWT) to a covert, extended-range weapon for Anti-Surface Warfare (ASuW), Anti-Submarine Warfare (ASW), or limited Precision Strike (PSTK) missions.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	03	0603673N		1,000	22,233
Navy	Future Naval Capabilities Advanced Tech Dev	Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation (FNC)	A package of advanced materials that will realize an improvement of 3X or more in engine life at higher operating temperatures.	Increase Warfighter Capability	Materials and Design	1319	03	0603673N		3,976	13,975
Navy	Future Naval Capabilities Advanced Tech Dev	Air Independent Propulsion System (FNC)	Enable energy dense propulsion systems to support long endurance undersea vehicle missions.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	03	0603673N		806	3,586
Navy	Mobility Fuels	Tactical Fuels Research and Development	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.	Reduce Logistics Risks to Mission	Conventional Fuels Testing	1319	04	0603724N		8,100	40,767

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Aircraft Energy Conservation	Opportunity Studies	The aircraft energy conservation RDTE project identifies, 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.	Increase Warfighter Capability	Platform Upgrades Air	1319	04	0603724N		2,977	21,890
Navy	Aircraft Energy Conservation	Enhanced Core Development	Optimize the fuel efficiency of the engine core with various technologies, including ceramic matrix composites (CMC), performance seeking controls (PSC), advanced seals, advanced aerodynamics, and other. Studies are in work to determine platform of interest to include F/A-18E/F and E/A-18G platform and/or NGAD.	Increase Warfighter Capability	Propulsion Upgrades Air	1319	04	0603724N		1,500	13,500
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 maintenance.	Enhance Mission Effectiveness	Current Operations Tools	1319	04	0603724N		700	5,300
Navy	Aircraft Energy Conservation	CH-53K Engine Efficiency	Optimize the fuel efficiency of the Ch-53K engine with various technologies, including improved deswirl/diffuser and advanced blade superfinish.	Increase Warfighter Capability	Propulsion Upgrades Air	1319	04	0603724N		-	4,000
Navy	Aircraft Energy Conservation	MQ-8C Engine Efficiency	Optimize the M250 engine utilizing an advanced recuperator design enabling 25% reduced specific fuel consumption (SFC). Reduced SFC provides extended time on station improvement of 25 - 35%, critical to ISR mission. These technologies will be forward and retro fit in MQ-8C platform.	Increase Warfighter Capability	Propulsion Upgrades Air	1319	04	0603724N		739	2,789
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.	Increase Warfighter Capability	Platform Upgrades Air	1319	04	0603724N		1,148	2,398

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Aircraft Energy Conservation	F-35 Engine Efficiency	Optimize the fuel efficiency of the F-35 engine with various technologies, including Advanced Technology HPC, Optimized Turbine Cooling, Advanced Technology HPT, Turbine Clearance Control, and Fuel Burn Optimized Control Mode. These technologies will be forward fit in F-35 Block 5 (2020) and beyond.	Increase Warfighter Capability	Propulsion Upgrades Air	1319	04	0603724N		4,140	4,290
Navy	Innovative Naval Prototypes (INP) Adv Tech Dev	Forward Deployed Energy & Communications Outpost (FDECO) - Energy	FDECO will prototype open, scalable and coordinated undersea energy, data and communications infrastructure for undersea vehicles and sensors. FDECO presents a scalable underwater replenishment network in the form of modularized, platform-independent outposts, "hotspots" for energy, secure communications, and data sharing between undersea platforms. FDECO energy (50% of total FDECO funding) is assigned to Energy portfolio. INP-FDECO starts in FY16	Increase Warfighter Capability	Mobile Fuel Assets	1319	03	0603801N		-	4,927
Navy	Hybrid Electric Drive (HED)	HED Backfit for DDG 51 CL FL IIA	The Hybrid Electric Drive (HED) consists of an electric motor which can be coupled to the propulsion reduction gear to provide propulsion power from the ship service gas turbine generators (SSGTGs) during low speed operations. This will permit the securing of one or more propulsion gas turbines and allow higher power loading resulting in more efficient operation of the SSGTGs, which will be generating electric power for the HED as well as ship service power. In addition to reducing fuel consumption and the associated costs, HED results in the additional benefits of increasing the ship's range, increased time on station performing its mission, and reducing the frequency of fuel replenishment.	Enhance Mission Effectiveness	Propulsion Upgrades Sea	1319	05	0604567N		-	986

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Hybrid Electric Drive (HED)	HED Backfit for DDG 51 CL FL IIA	The Hybrid Electric Drive (HED) consists of an electric motor which can be coupled to the propulsion reduction gear to provide propulsion power from the ship service gas turbine generators (SSGTGs) during low speed operations. This will permit the securing of one or more propulsion gas turbines and allow higher power loading resulting in more efficient operation of the SSGTGs, which will be generating electric power for the HED as well as ship service power. In addition to reducing fuel consumption and the associated costs, HED results in the additional benefits of increasing the ship's range, increased time on station performing its mission, and reducing the frequency of fuel replenishment.	Enhance Mission Effectiveness	Propulsion Upgrades Sea	1810	01	0708017N		10,933	17,264
Navy	Fleet Energy Managers	Fleet Energy Managers	Fleet Energy Managers (FEMS) to support development of policy and oversight for Operational Energy program	Enhance Mission Effectiveness	Metering and Monitoring	1804	04	0708017N		2,122	2,122
Navy	Fleet Energy Managers	Fleet Energy Managers	Fleet Energy Managers (FEMS) to support development of policy and oversight for Operational Energy program	Enhance Mission Effectiveness	Metering and Monitoring	1804	01	0708017N		-	2,198
Navy	Common Group Equipment	Simulator Upgrades	The Navy Aviation Simulator Master Plan (NASMP) identified capability (fidelity) and capacity upgrades required to maximize TandR simulation for F/A-18E/F, EA-18G, and MH-60R/S aircraft given fiscal, technological, and minimum flight time limitations.	Enhance Mission Effectiveness	Simulators Aviation	1506	07	0804743N		68,855	291,395
Navy	Advance Surface Machinery Sys	Energy Storage	ESO is responsible for developing Next Generation Integrated Power and Energy System (NGIPES) 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).	Increase Warfighter Capability	Alternative Power Sources	1319	04	0603573N		2,500	3,500

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Advance Surface Machinery Sys	Advanced Power Generation Module	Advanced Power Generation Module (APGM) includes back fit and forward fit developments including the AG9160RF, 25MW Gas Turbine Generator (GTG), and Gas Turbine (GT) efficiency upgrades. The AG9160RF Gas Turbine Generator (GTG) is an upgrade to the DDG1000 auxiliary gas turbine and will provide increased power to meet DDG51 Flight III requirements for advanced sensors and future weapons with reduction in life cycle costs through increased fuel efficiency over legacy gas turbine generator sets. 25MW GTGs will adapt an aero derivative fuel efficient GT to improve fuel efficiency 12-15% over current single shaft GTs, reduce total ownership costs, and increase time on station. GT upgrades will provide operational readiness and fuel efficiency improvements to existing GT engines for both back fit and new construction ships.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	04	0603573N		4,125	15,007
Navy	ENERGY CONSERVATION	Auxiliary Systems	This project will be utilized to identify, test and evaluate new technologies for shipboard auxiliary systems aimed at reducing fuel consumption.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		209	1,153
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.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		-	1,803
Navy	ENERGY CONSERVATION	Energy Monitoring & Assessment	This project area will focus on methods of capturing and displaying energy related data to shipboard personnel as actionable information for ships force to employ energy conservation measures underway and in port as mission requirements permit.	Increase Warfighter Capability	Metering and Monitoring	1319	04	0603724N		4,388	21,311
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.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		-	655

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
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.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		114	679
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.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		240	515
Navy	ENERGY CONSERVATION	Maritime Energy Efficiency R&D	This supports overall FRRDP execution and currently unidentified projects in the out-years of the FYDP.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		4,532	4,532
Navy	ENERGY CONSERVATION	Power Generation and Storage	This project area will accomplish development, laboratory and Fleet testing to determine overall mission and cost effectiveness of improved power generation and storage technologies.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		-	-
Navy	ENERGY CONSERVATION	Propulsion Systems	This project will be utilized to identify requirements and perform land based and shipboard testing of ship propulsion system improvements on Gas Turbine, Steam, and Diesel Engine systems to reduce overall fuel consumption and lower maintenance costs.	Increase Warfighter Capability	Propulsion Upgrades Sea	1319	04	0603724N		114	456
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.	Increase Warfighter Capability	Platform Upgrades Sea	1319	04	0603724N		-	1,042
Navy	Maritime Energy Initiatives (MEI)	DDG 51 Solid State Lighting (SSL)	Replaces 50W and 110W incandescent globes fixtures and 1, 2, and 3 lamp fluorescent bulbs with LEDs to reduce energy usage. Install also reduces electrical lighting load, maintenance actions, HAZMAT, and space needed for spare parts.	Enhance Mission Effectiveness	Platform Upgrades Sea	1810	01	0204228N		3,218	11,360

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Maritime Energy Initiatives (MEI)	DDG 51 Thermal Management Control System (TMCS)	Provides centralized control and monitoring of space temps at design set-points for each compartment throughout the ship. Technology enables improved operational efficiency of the HVAC system, thereby lowering AC loads and reducing electrical demand.	Enhance Mission Effectiveness	Platform Upgrades Sea	1810	01	0204228N		9,235	18,634
Navy	Maritime Energy Initiatives (MEI)	DDG 51 Variable Speed Drive for Collective Protection System (VSD CPS)	Incorporates modern VSD controls to adjust fan speeds to suit conditions and reduce energy consumption under normal operating conditions. VSDs used to control CPS supply fans to optimize supply air flow so that energy savings from fan motors and reduced HVAC loads can be realized. Alteration also provides greater situational awareness of CPS and	Enhance Mission Effectiveness	Platform Upgrades Sea	1810	01	0204228N		3,365	8,394
Navy	Maritime Energy Initiatives (MEI)	DDG 51 FLT IIA Bulbous Bow	Modifies bow shape to reduce hull wave drag without an increase in hull resistance. Alteration reduces fuel consumption and emissions, and increases range, time-on-station and periods between refueling.	Enhance Mission Effectiveness	Platform Upgrades Sea	1810	01	0204228N		-	-
Navy	Maritime Energy Initiatives (MEI)	DDG 51 FLT IIA Shipboard Energy Dashboard (SED FLT IIA)	Shipboard tool providing real-time situational awareness of the energy demand associated with equipment line-ups and mission for DDG FLT IIA platforms.	Enhance Mission Effectiveness	Metering and Monitoring	1810	01	0204228N		-	-
Navy	Maritime Energy Initiatives (MEI)	DDG 51 FLT I Shipboard Energy Dashboard (SED FLT I)	Shipboard tool providing real-time situational awareness of the energy demand associated with equipment line-ups and mission for DDG FLT I platforms.	Enhance Mission Effectiveness	Metering and Monitoring	1810	01	0204228N		-	-
Navy	Maritime Energy Initiatives (MEI)	DDG 51 FLT IIA Triton Fuel Penalty (Triton)	System reports in real time when a ships powering condition has degraded due to increased drag from bio-fouling, enabling Navy personnel to schedule ship cleanings	Enhance Mission Effectiveness	Metering and Monitoring	1810	01	0204228N		-	-
Navy	POWER PROJECTI ON APPLIED RESEARC H	NRL Base - Energy	Long term Basic and Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Individual/Warf ighter Power	1319	02	0602114N		375	5,307

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	UNDERSEA WARFARE APPLIED RESEARCH	NRL Base - Energy	Long term Basic and Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Individual/Warfighter Power	1319	02	0602747N		515	2,751
Navy	Future Naval Capabilities Applied Research	Combat Power and Energy Control System	Combat Power and Energy Control System that enables high power electric weapons and sensors through the automated control of distributed, shared energy generation and storage resources.	Increase Warfighter Capability	Power Controls and Distribution	1319	02	0602750N		-	6,039
Navy	Future Naval Capabilities Applied Research	High Power Solid State Circuit Protection for Power Distribution and Energy Storage (FNC)	Develop components and methods to quickly detect and clear electrical faults, replacing slow-acting circuit breakers and protective relays for medium voltage (MV) DC applications.	Increase Warfighter Capability	Power Controls and Distribution	1319	02	0602750N		1,487	3,328
Navy	Future Naval Capabilities Applied Research	Multi-Function High Density Shipboard Energy Storage (FNC)	Energy Storage System that enables multiple load operation from minimal total installed storage with the following characteristics: Enables High pulse weapons and sensor loads, (2) Reduces fuel consumption, and (3) Safe, reliable, standardized, power-dense package.	Increase Warfighter Capability	Power Controls and Distribution	1319	02	0602750N		-	3,077
Navy	Future Naval Capabilities Applied Research	Compact High Density Tactical Energy Storage (FNC)	Energy Storage system that is adaptable/scalable for multiple USMC system operations with following characteristics: (1) Reduces need for fuel resupply, (2) Supports future high pulse loads, and (3) Common use, transportable, high density.	Increase Warfighter Capability	Power Controls and Distribution	1319	02	0602750N		525	1,030

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Innovative Naval Prototypes(INP) Applied Res	Forward Deployed Energy and Communication s Outpost (FDECO) - Energy	FDECO will prototype open, scalable and coordinated undersea energy, data and communications infrastructure for undersea vehicles and sensors. FDECO presents a scalable underwater replenishment network in the form of modularized, platform-independent outposts, "hotspots" for energy, secure communications, and data sharing between undersea platforms. FDECO energy (50% of total FDECO funding) is assigned to Energy portfolio. INP-FDECO starts in FY16	Increase Warfighter Capability	Mobile Fuel Assets	1319	02	0602792N		-	5,223
Navy	Future Naval Capabilities Advanced Tech Dev	Combat Power and Energy Control System	Combat Power and Energy Control System that enables high power electric weapons and sensors through the automated control of distributed, shared energy generation and storage resources.	Increase Warfighter Capability	Power Controls and Distribution	1319	03	0603673N		-	9,995
Navy	Future Naval Capabilities Advanced Tech Dev	Multi-Function High Density Shipboard Energy Storage (FNC)	Energy Storage System that enables multiple load operation from minimal total installed storage with the following characteristics: Enables High pulse weapons and sensor loads, (2) Reduces fuel consumption, and (3) Safe, reliable, standardized, power-dense package.	Increase Warfighter Capability	Power Controls and Distribution	1319	03	0603673N		4,385	8,789
Navy	Future Naval Capabilities Advanced Tech Dev	High Power Solid State Circuit Protection for Power Distribution and Energy Storage (FNC)	Develop components and methods to quickly detect and clear electrical faults, replacing slow-acting circuit breakers and protective relays for medium voltage (MV) DC applications.	Increase Warfighter Capability	Power Controls and Distribution	1319	03	0603673N		2,751	7,451
Navy	Future Naval Capabilities Advanced Tech Dev	Compact High Density Tactical Energy Storage (FNC)	Energy Storage system that is adaptable/scalable for multiple USMC system operations with following characteristics: (1) Reduces need for fuel resupply, (2) Supports future high pulse loads, and (3) Common use, transportable, high density.	Increase Warfighter Capability	Power Controls and Distribution	1319	03	0603673N		1,054	2,007

ORG	OE Program Title	OE Initiative Title	OE Program Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2016	FY 2017	FYDP
Navy	Innovative Naval Prototypes (INP) Adv Tech Dev	Forward Deployed Energy and Communication s Outpost (FDECO) - Energy	FDECO will prototype open, scalable and coordinated undersea energy, data and communications infrastructure for undersea vehicles and sensors. FDECO presents a scalable underwater replenishment network in the form of modularized, platform-independent outposts, "hotspots" for energy, secure communications, and data sharing between undersea platforms. FDECO energy (50% of total FDECO funding) is assigned to Energy portfolio. INP-FDECO starts in FY16	Increase Warfighter Capability	Mobile Fuel Assets	1319	03	0603801N		-	4,927
								Total Navy OE		287,355	1,340,010

Table 12. Defense-Wide FY 2017 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 2016	FY 2017	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	1,000	2,229	9,611
DLA	Battery Network (BATTNET)	Energy Efficiency & Alternative Energy Technologies - Batteries	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	2,598	1,071	9,626
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		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	27,845
								TOTAL Defense Wide OE	41,114	46,787	244,127