

Fiscal Year 2018 Operational Energy Annual Report



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**Office of the Under Secretary of Defense for
Acquisition and Sustainment**

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Introduction

The Department of Defense (DoD) Operational Energy Annual Report satisfies the requirements in section 2925(b) of title 10, United States Code for fiscal year (FY) 2018. 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.²

In FY 2018, the Department consumed over 85 million barrels of fuel to power ships, aircraft, combat vehicles, and contingency bases (see Appendix A). This level of energy use has been relatively steady since FY 2013, and reflects stable 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 2018³.

During FY 2018, the Department continued to revise its organization for energy to meet current and future demands. Operational energy responsibilities were aligned under a new Deputy Assistant Secretary of Defense (DASD) for Energy – responsible for energy resilience across all forces and facilities – in the newly established Office of the Assistant Secretary of Defense for Sustainment (ASD(S)) and Office of the Under Secretary of Defense for Acquisition and Sustainment (USD(A&S)).

The Department reviewed the status of the FY 2018 targets in the *Operational Energy Strategy*, and confirmed that the Department is considering energy a fundamental enabler of military capability and is aligned with leadership priorities.

In January 2018, the Department of Defense published a new *National Defense Strategy* (NDS) that placed increased emphasis on ensuring mission accomplishment through more lethal and resilient forces. The unclassified NDS summary detailed three lines of effort: Build a More Lethal Force, Strengthen Alliances and Attract New Partners, and Reform the Department for Greater

“Today, our nation faces a growing threat to our security, highlighted by a return to great power competition and the very real possibility of fighting our next conflict in a highly contested environment.”
– ASD(S) Robert H. McMahon during his confirmation hearing, Senate Armed Services Committee, 21 Aug 2018

¹ The *Operational Energy Strategy* can be found at

http://www.acq.osd.mil/eic/Downloads/OE/2016%20OE%20Strategy_WEBd.pdf

² the language of 10 USC § 2925 can be found at: <https://www.law.cornell.edu/uscode/text/10/2925>

³ Per DLA

Performance and Affordability. Operational energy initiatives support each of these lines of effort by increasing lethality through assuring the delivery of energy where and when it is needed, strengthening partnerships with key allies in areas of potential conflict, and changing how the Department treats energy as a business process. Together, the Department is increasing the ability to sustain mission effectiveness amid contested operating environments and disruptions in the supply of fuel.

The distribution and sustainment challenges caused by contested environments and the NDS priorities will continue to drive the Department's investments. The Department will invest in more resilient capabilities and systems in support of future concepts of operation. These include increases in range, reach, time-on-station, and performance of platforms and soldiers of the nation's deployed forces.

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 five for completion in FY 2018. These targets are associated with identifying and reducing risk, and summarized in **Table 1**.

Table 1: OE Strategy Targets for FY 2018

Objectives	Goals	Targets	Status
Increase Capabilities	Institutionalize Energy Supportability Analyses (ESAs) in Capability Development	Ensure ESAs are used in all acquisition programs that use operational energy and were established in FY 2016 and later	Complete
	Improve Combat Effectiveness and Supportability	Increase energy supportability, as measured against current capabilities, in 100% of all new acquisition programs	Complete
Identify and Reduce Risks	Identify and Mitigate Energy Related Risks in Deliberate Planning	Mitigate or accept 100% of identified OE risks	Complete
Enhance Current Mission Effectiveness	Improve Energy Behavior	Measure OE consumption by type of equipment	Partially Complete
		Include OE principles in required PME courses on strategy, logistics, and campaigning, as well as in general military training within the DoD	Complete

Ensure ESAs are used in all acquisition programs that use operational energy and were established in FY 2016 and later.

Background. As set forth in 10 U.S.C. Section 2926, the role of operational energy in the Department’s requirements and acquisition process is guided by the Energy Key Performance Parameter (KPP) in the Joint Capabilities Integration and Development System (JCIDS) Manual and in DoD Instruction (DoDI) 5000.02, Operation of the Defense Acquisition System. DoDI 5000.02 directs the Military Departments to consider possible tradeoffs among life-cycle cost, schedule, and mandatory KPPs for each alternative considered during an Analysis of Alternatives. In order to comply with DoDI 5000.02, the Military Departments must conduct the ESA and develop the Energy KPP. ESAs facilitate the identification of energy shortfalls and informs decisions on risk mitigation, such as changes in system design, the Concept of Operations (CONOPS), force structure, and procuring additional logistics.

Assessment. This target is complete, but efforts to ensure ESAs are completed for all new acquisition programs are ongoing. The Services and ODASD(Energy) continue to work on

utilizing ESAs for all acquisition programs that use operational energy.

Increase energy supportability, as measured against current capabilities, in 100% of all new acquisition programs.

Background. The 2018 *National Defense Strategy* establishes the objective to build a more lethal force. A more lethal force may require more energy as new capabilities come online, and new concepts of operation (CONOPs) may increase energy requirements in the field. Investing in these technologies and concepts without understanding what they will mean for energy supportability could leave gaps in operations during conflicts. Building on the ESAs noted earlier, acquisition programs should be able to document improved ability to be sustained in contested environments. New acquisition programs must be energy supportable if the military is to succeed in their operational goals. DoD and the Services are identifying ways to increase supportability of missions and platforms to enable a more lethal force.

Assessment. This target is complete, but efforts to increase energy supportability are ongoing. Services are evaluating energy supportability on new programs as they are created. In 2018, the Air Force performed an ESA for the KC-46A, and identified infrastructure-related shortfalls now being addressed by the Air Force. The Navy has installed a Hybrid-Electric Drive on the USS Truxton and the Global Energy Information System (GENISYS) on the USS Mason, and is evaluating their effectiveness to extend the operational reach and time-on-station of Guided Missile Destroyers (DDGs).

Mitigate or accept 100% of identified OE risks.

Background. The *Operational Energy Strategy* directed the inclusion of energy related risks in deliberate planning. Combatant Command Campaign and Posture Plans incorporated operational energy and energy security aspects which affect access, agreements, logistics sufficiency, and integrated priorities. Logistics assessments for fuel and/or energy sufficiency are conducted for Operational and Contingency Plans, and are reflected in the Chairman's Risk Assessment, Joint Logistics Estimate, and Global Logistics Readiness Dashboard.

Assessment. This target is complete, but efforts to mitigate operational energy risks are ongoing. The Department, including the OSD staff, Joint Staff and Services are working to identify OE-related risks to operations and plans. The Marine Corps completed energy risk assessments for the Joint Forcible Entry Operations program, and the Navy reviewed energy and logistics risks for Pacific-oriented OPLANS. The Navy also conducted the Naval Aggregate Force Study to integrate energy risk assessments for all Naval Operations.

Measure OE consumption by type of equipment.

Background. Because of energy challenges associated with operational requirements, the supportability of emerging concepts, the consequences of disruptions in the delivery of fuel, and the challenges of operating in contested environments, the Department needs comprehensive and timely information on the use of energy by Joint forces.

Assessment. This target is partially complete. The Navy now measures fuel consumption by type of equipment. The Air Force is working to collect fuel consumption data from all platforms, but not all Air Force platforms currently collect and report data, and some lack the equipment to do so. Additionally, due to the large number of different pieces of equipment and platforms, the Army and Marine Corps are not yet able to measure fuel consumption by type of equipment. The Army continues to refine the requirements for a system of bulk fuel accountability that will provide enterprise-wide visibility of demand and consumption down to the retail level. The Army expects to complete a capabilities requirements document in Fiscal Year 2019.

Include OE principles in required PME courses on strategy, logistics, and campaigning, as well as in general military training within the DoD.

Background. Effective use of energy requires that Service members at all levels understand how energy affects missions and capabilities. Leadership and general military training within the Services need to include courses and information regarding energy's role as a key constraint or enabler of mission success. Once the risks and opportunities associated with energy use are understood, Service members will need the training, education, and policy support to make real-time changes in how Joint forces operate around the globe.

Assessment. This target is complete, but efforts to include operational energy principles in required PME courses and general military training within the DoD are ongoing. Service schools have incorporated operational energy principles into training at multiple levels. The Air Force has created material on operational energy-related topics for the Air Combat Command and Air Mobility Command Squadron Commanders Courses, Global Ready Aircraft Commanders Course, and Air University Pre-Command Training. The Army has Operational Energy PME developed for all levels, up to and including War College. The Army also routinely produces communications on operational energy for the force.

Operational Energy Initiatives in FY 2018

As the Department sustained the Operational Energy Strategy and aligned to the priorities of the NDS, the operational energy team maintained a broad set of initiatives to assure the delivery of energy to the warfighter.

Office of the Secretary of Defense

Within the Office of the Secretary of Defense, the OASD(S) and DLA Energy led operational energy activities in FY 2018.

ASD(S)

In accordance with title 10 U.S.C 2926(e), ASD(S) reviewed the adequacy of the President's Budget for carrying out the *Operational Energy Strategy*. The Department performed a review of the FY 2019 President's Budget and concluded the budget was adequate for implementing the strategy. The Department also began review of the FY 2020 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 2019.

The Department continued to review existing policy and doctrine to ensure alignment with emerging lines of effort. This included reviews and revisions of various DoD Issuances, including a major revision to Department of Defense Directive (DoDD) 4120.11 to reissue it as a DoDI. DoDI 4120.11, *Mobile Electric Power Systems (MEPS)*, assigns the Army as the acquiring department and lead standardization activity responsible for MEPS, and creates a MEPS Program Office at the Army Program Manager Expeditionary Energy and Sustainment Systems (PM E2S2). The Army develops and acquires a standard family of MEPS solutions for all Services. This revision extends these standard systems from just power generation to include battlefield electrical storage, distribution and management systems, and creates a waiver process for the Services to use if the standard family does not meet requirements.

Policy and Doctrine Actions in FY 2018

- DoDI 4120.11, Mobile Electric Power Systems
- DoD Manual 4140.25, DoD Management of Energy Commodities
- Joint Publication 4-0, Joint Logistics
- Joint Publication 4-09, Distribution Operations

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 military doctrine.

OASD(S) continued to shape the experimentation, analysis, and review of future warfighter capabilities and future force architectures. For instance, staff from ODASD(Energy) participated in Service and agency wargames as subject matter experts in operational energy strategies, concepts, modeling, and simulation. ODASD(Energy) 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(Energy) played key roles in the Army's 2018 Unified Quest wargame, DLA's 2018 logistics game, Air Force's 2018 Global Engagement, and TRANSCOM's 2018 wargame. ODASD(Energy) expects to participate in the Air Force's 2019 Futures Game and the Army's 2019 Unified Quest wargame as well as other wargames as schedules and details are worked out.

ODASD(Energy) 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).

Looking at FY 2019, ODASD(Energy) will continue to integrate the Installation Energy and Operational Energy programs into a single office. This effort will include a focus on energy resilience, creating a DoD Energy Strategy that meets the Congressional requirement for an operational energy strategy, and updating issuances to reflect current organization and guidance.

Defense Logistics Agency

As the Nation's combat logistics support agency, DLA's mission is to provide best value integrated logistics solutions to America's Armed Forces and interagency customers in peace, during national disasters and emergencies, and in war, around the clock and around the world. As the Executive Agent for Bulk Petroleum, DLA has the responsibility to perform end-to-end analysis of risk and performance, and engages in planning to focus DoD resources on mitigating risks, enhancing mission effectiveness, and avoiding unnecessary redundancies in managing the DoD bulk petroleum supply chain. DLA's contributions to the Department's operational energy objectives focus on reducing operational risks and enhancing current mission effectiveness of commercial-grade petroleum fuels and alternative (non-petroleum) fuels, as well as the DoD battery supply chain.

The following specific initiatives highlight DLA Energy's operational energy accomplishments during FY 2018:

- In January 2018, DLA Energy hosted the annual Joint Petroleum Seminar (JPS), which is traditionally attended by over 100 participants from across the DoD petroleum community. The JPS provides overviews of important policies, addresses strategic and operational issues, explains and demonstrates supporting systems and applications, details Military Service petroleum and energy programs. Mid and high level DoD petroleum community members receive several days of high-level briefings and discussions with the intent of expanding their professional petroleum knowledge.

- DLA began implementation of a comprehensive additive injection policy to establish expeditionary additization capability to provide a resilient supply chain. DLA Energy collaborated with INDOPACOM, PACAF, and AFPET to build 40 palletized additization kits. Each kit contains the required military additives to convert 280,000 gallons of commercial jet fuel to military specification jet fuel, and these kits have been prepositioned at three DLA Distribution Centers in the Pacific Theater to support the Air Force.
- The Energy Readiness Program funded a project to establish a microbial monitoring program to reduce operational costs associated with bio deterioration and bio-corrosion of fuels in bulk storage tanks. The outcome of the one-year project validated new field test methods that will provide a broad spectrum field test for microbial populations and type within fuel supplies. Combining proper sampling and test results with physical evaluation of fuel system condition will provide a basis for advance warning of microbial growth as well as evaluating tank cleaning effectiveness through test results.
- Two contracts were initiated under the DLA Battery Network manufacturing technology R&D program that focus on improving the supply and reducing the costs of batteries used in fielded weapons systems or by individual soldiers. One is developing low cost, high quality, domestically produced, lithium-ion replacement cells for the Army's conformal wearable battery, while the other is developing advanced bi-polar lead-acid batteries to replace flooded lead-acid configurations still used in DoD ground systems with significant improvements in cost, energy density, and weight.

In FY 2019, DLA will continue to improve support to operational energy programs. Future Battery Network initiatives will include developing other manufacturing technology to scale-up and transition solid-state technologies, which enable safer high energy applications. DLA will also be assessing the training needs of DoD stakeholders within the energy community and fielding new distance learning courses on Joint Petroleum Advanced Planning and Bulk Petroleum Operations. Additionally, DLA will be modifying the packaging of prepositioned fuel additive kits to support smaller requirements in remote locations and identifying requirements for changes to its information systems that take into account gaps in operational energy data capture and use.”

Air Force

The Air Force remains the DoD’s largest consumer of operational energy, with \$1.2 billion spent on Air Force aviation fuel in FY 2018. Exploiting technology and expanding the art of the possible enable the Air Force to optimize operational energy usage to enhance combat capability and readiness. The Air Force collects and analyzes data from across the enterprise to make informed decisions for technology and process improvements.

Air Force operational energy efforts directly support the goals of the *National Defense Strategy*. Forward force maneuver and posture resilience are elements of a more lethal force, and are enhanced by initiatives developing unmanned aerial systems (UAS) capable of greater range and reduced logistical requirements, the introduction of hybrid propulsion systems as well as exploring liquid natural gas propulsion. Operational planning tools that optimize resource alignment further reduce operating footprint, increase agility and provide resilience. Impacting reform in cost, supportability and efficiency is achieved through energy optimization efforts—both materiel and process oriented—that result in increased aircraft lifespan, lower aircraft maintenance costs and more training opportunities. Lastly, in building partnerships and strengthening alliances, the Air Force is working with multinational partners to improve the aerodynamics of mobility aircraft.

The Air Force is pursuing multiple operational energy lines of effort, seeking to enhance aircraft aerodynamics, jet engine performance, data collection and analysis, flight planning and mission execution, aircraft maintenance and sustainment, and fuel logistics in wargaming. The Air Force also has a strong operational energy outreach program, establishing research awards with Air University and the US Air Force Academy, and funding the Air Force Institute of Technology energy engineering courses as well as providing courseware to MAJCOMs. The Air Force developed a digital operational energy library populated with studies, lessons learned and operational energy analysis for use across the enterprise. Energy Action Month increased awareness to build an operational energy-informed culture. With 678,000 Twitter followers, 50,000 Facebook friends, 30+ website posts, 10 articles shared by media outlets and 5 InfoNet ads posted at the Pentagon, Marks Center and Crystal City, FY 2018 was a banner year for Air Force operational energy outreach.

As our national defense posture evolves, Air Force operational energy provides senior leadership and warfighters with greater capability to execute the *National Defense Strategy*. With the shift to the near-peer competition, as well as our on-going efforts to counter non-state actors, the tyranny of distance and the need for persistent surveillance factor greatly into our effectiveness.

The following specific initiatives highlight the Air Force's operational energy accomplishments during FY 2018:

- Until recently, Combined Air Operations Center (CAOC) tanker planers used a mix of spreadsheets, manual calculations, and whiteboards. The Defense Innovation Unit worked with the CAOC to develop software that streamlined the development of aerial refueling schedules and reduced process time from 8-12 hours to 4 hours. The new approach also improved tanker asset utilization by 3.6 percent, reducing the number of required tanker sorties per day by 1.8. By increasing the effectiveness of each sortie, the Air Force could meet mission requirements with 180,000 fewer gallons per week and 9 fewer aircrews. The next iteration of the system interfaces with existing air operation

center systems to optimize the matching of tankers to users. These improvements will reduce scheduling time from hours to minutes, and reduce the number of tanker aircraft required in theater, along with associated aircrew, maintenance crews and support infrastructure.

- Adaptive jet engines will provide 35 percent greater range/loiter time for 5th generation fighter aircraft and beyond. Unmanned aerial systems such as Ultra LEAP and Alpine bring incredible endurance, the latter able to stay on station for six days on just 120 gallons of fuel. This provides unprecedented over-watch in semi-permissive environments. Further, their small logistics footprint and great range enable very flexible basing options, a key to operating in areas such as the Pacific and sub-Saharan Africa.
- Air Force operational energy moderated the 2018 NATO Big Data and Artificial Intelligence Conference. Speaking engagements included the keynote speech at the Defense Innovation Summit, the keynote speech at the Operational Energy Summit, a senior leader panel at the Aviation Week MRO Military Symposium, and a panel at the Airlift Tanker Association on investing in tools to optimize worldwide MAF ops.
- For the Air Force's Title X wargame, Global Engagement 2018, and its companion effort, Long Duration Logistics Wargame 2018, Air Force Operational Energy established an Energy Planner role within Blue Force, along with a Modeling and Simulation Planner role in Game Design, Planning and Adjudication. Through this integration, Air Force Operational Energy ensured Air Force leadership took operational energy into account during operational planning as well as when prioritizing Military Construction and platform investments. Further, playing a detailed energy framework for the wargame highlighted critical areas of risk and opportunity, helping to shape and influence future theater infrastructure and Concepts of Operation.

Looking to the year ahead, Air Force operational energy will continue to push the envelope in technology and process improvements. Examining KC-135 aerodynamics supports its extended service life and operational effectiveness. Equipping the C-17 fleet with low cost aft body drag reduction devices will save the Air Force \$10 million per year in fuel, with a return on investment of less than six months. Exploring new and scalable technologies for aircraft propulsion can vastly change the landscape of future operations and basing requirements. Championing the lifting wing body design for mobility and tanker aircraft is paramount to continued US leadership in global aviation. A lifting wing body design is 69 percent more fuel efficient (Range/1000 lb fuel), and has greater lift capacity and speed while also being more survivable. Energy innovation is key to global airpower dominance and a more lethal force.

Army

Army operational energy initiatives in FY 2018 were accompanied by a range of

overarching changes in organization and priorities. Following confirmation in November 2017, Army Secretary Mark Esper established three priorities of readiness, modernization, and reform. These priorities support the National Defense Strategy’s directives to build a more lethal force and reform the department for greater performance and affordability.

On July 1, 2018, the Army formally activated a new four-star headquarters, Army Futures Command. This marks the most significant Army reorganization effort since 1973. Army Futures Command will establish unity of command and effort by consolidating the modernization enterprise. The Army Futures Command is tasked with developing future warfighting concepts, generating innovative solutions through research and development, and building the next generation of combat systems.

This action formalized the structure of eight cross-functional teams established in October 2017 to focus on the Army’s six modernization priorities: Long-Range Precision Fires, Next Generation Combat Vehicle, Future Vertical Lift, Army Network, Air and Missile Defense, and Soldier Lethality. The cross-functional teams are working to accelerate the process of developing, acquiring, and fielding new technologies and capabilities, focusing on a handful of high priority projects in each portfolio. The development of power and energy capabilities, particularly battlefield storage, are inherent in each of these priorities.

Now known as “Multi-Domain Operations”, the Army published “Multi-Domain Battle: Evolution of Combined Arms for the 21st Century” in December 2017. This concept describes a future operating environment that will be more contested, and acknowledges the realities stated in the National Defense Strategy. The document describes how potential adversaries have studied Army capabilities and developed the means to counter once-guaranteed “overmatch.” Potential adversaries have demonstrated asymmetric capabilities that deny access to theaters, disrupt the supply of energy, challenge the unity of coalitions, and negate freedom of action at the operational and tactical levels. Although it is outside the scope of this report, it is important to note that in December 2018, the Army published “The U.S. Army in Multi-Domain Operations 2028” as its new operating concept.

To meet these challenges, Army forces must be able to conduct maneuver in all domains – land, air, sea, space, and cyberspace – while operating semi-independently and dispersed at extended distances. Multi-domain challenges threaten reliable access to resupply on the future battlefield, and independent brigades must have the capability to conduct offensive operations for 72 to 96 hours. To inform the development of materiel and non-materiel solutions that will enable reaching that goal, the Army published a white paper on demand reduction in February 2018. The white paper identifies, the Army must simultaneously reduce demand by at least 30% while improving its ability to support Brigade Combat Teams on the modern battlefield and identifies components of the solution.

The goal of extended range, coupled with energy-intensive new capabilities (e.g.

directed energy weapons and active protection systems), is the driving force behind the Army's investments in operational energy technologies. These investments enhance capability, extend range and endurance, enable movement and maneuver, support freedom of action, and reduce risks and costs—all of which contribute to the maneuver commander's ability to complete the mission.

The following specific initiatives highlight the Army's operational energy accomplishments during FY 2018:

- The Army began production on the upgraded Stryker “Double-V Hull A1” vehicle. The contract award calls for delivery of 116 DVH A1 vehicles by FY 2020. In addition to the more survivable hull, the Stryker upgrades include replacement of the 350-horsepower engine with a 450-horsepower engine, an upgraded 910 amp alternator, and improved power architecture. As a result, the Stryker regains mobility lost as protection requirements increased, and provides sufficient electrical power to integrate and sustain current and future capabilities.
- The M109A7 Self-Propelled Howitzer (SPH) and M992A3 Carrier Ammunition Tracked (CAT), formerly known as the Paladin Integrated Management (PIM) program began fielding under a Conditional Material Release (CMR) in FY18. The First Unit Equipped (1/1 ID) received their vehicles in 2QFY18. Upgrades on this system, including a new chassis, provide enhanced mobility, survivability, and force protection. Incorporating Bradley Fighting Vehicle common parts (engine, transmission, final drive, and suspension), reduces the overall logistical footprint to support this system. Additionally, the 600V system that replaced the hydraulic components, simplifies maintenance and increases reliability. The growth capability in Size, Weight, Power, and Cooling (SWAP-C) enable future technology insertions to increase range and rate of fire (ERCA).
- The Joint Light Tactical Vehicle (JLTV), a replacement for the High-Mobility, Multi-Purpose Wheeled Vehicle (HMMWV) that has been in service since 1984, completed multiservice operational testing and evaluation in FY 2018. The Army expects a full-rate production decision in 3Q FY 2019. The JLTV uses a commercial off-the-shelf power train that increases mobility and provides onboard AND EXPORTABLE electric power sufficient to meet future requirements. Additionally, the JLTV will improve fuel economy when idling by as much as 30 percent over the HMMWV.

The Army continues to drive organizational and technological change to increase energy performance. Multi-Domain Operations and new goals for operational independence of field units has the potential to increase energy demand in the field. A reorganized Army, with energy as a cross-cutting enabler, and will support innovations and ensure that new CONOPs and goals are met without impacting mission effectiveness.

Department of the Navy

In FY 2018, the Department of the Navy's operational energy program focused on power and fuel in support of platforms, advanced sensors, and directed energy weapons systems, fuel distribution in contested environments, and developing systems that provide commanders information about their energy use in order to achieve a more lethal force with increased operational reach and time-on-station. In January, the Secretary moved operational energy under the Assistant Secretary of the Navy for Research, Development, and Acquisition in order to resource and guide operational energy capability development with the appropriate policy and resources.

Operational energy investments in the research and development necessary to address capability gaps are coordinated within the Navy and Marine Corps, with other services, and are greatly aided by the direct involvement of OSD through programs such as the Operational Energy Capability Improvement Fund (OECIF). Solutions necessary to address future weapons systems' high pulse power demands, alternative means of energy conversion, improved energy storage and management, and energy modelling capabilities have all benefitted from OSD's investments in both Navy and Marine Corps efforts.

Navy

The Navy's energy strategy has fully aligned to the National Defense Strategy and Naval Warfare CONOPS, and focuses on developing a lethal, agile, and resilient force posture and employment. The program addresses energy as a strategic resource that is essential to operational reach, mission effectiveness, and mission capabilities. The goal is to increase operational capability and resilience and enable distributed operations.

The following specific initiatives highlight the Navy's operational energy accomplishments during FY 2018:

- Energy Magazine – The next generation of shipboard weapons and sensor systems will require exceptional amounts of power, in unconventional forms that aren't achievable with our current shipboard electrical architectures. In FY 2018 the Navy invested heavily in R&D to ensure energy storage and distribution technologies are ready as pulse power systems are fielded. A technology and development roadmap lays out the approach and identifies development activities necessary. Those FY 2018 investments include Next Generation Integrated Power and Energy System (NGIPES), High Density Shipboard Energy Storage (multiple projects), Control of Power Science, Heat Transfer and Thermal Management Science, GENISYS, Hybrid Electric Drive, and the Electric Ship Research and Development Consortium.

- Energy Command and Control – The Navy recognizes the importance of situational awareness at every operating level. The Navy has significant investments in Command and Control technologies like GENISYS, for the Navy’s combatant and expeditionary forces, and Replenishment at Sea Planner (RASP) for logistics and fuel distribution planning.
- Autonomous Systems Power – Future operating strategies rely heavily on unmanned systems, and consequentially, the energy necessary to keep those systems fielded. The Navy continued R&D in advanced battery and energy storage alternatives for unmanned systems, along with the infrastructure necessary to keep those systems fielded. Projects like Large Displacement Unmanned Undersea Vehicle (LDUUV), Aluminum-Seawater Power System, and Undersea Weaponry Power and Energy are developed and coordinated onboard energy storage and architectures, while the Forward Deployed Energy and Communications Outpost (FDECO) developed a network of modularized, platform-independent outposts, for energy, secure communications, and data sharing between undersea platforms.
- Maritime Efficiency Initiatives – Navy’s maritime efficiency initiatives increase the operational reach of ships and help enable future high energy systems. Active technologies Thermal Management Control System and Hybrid Electric Drive Electric Propulsion System (HED EPS) both reduce the energy requirement by aligning performance to demand, in terms of cooling and speed, respectively. HED EPS field testing on USS Truxton began in late 2018, and results will inform future installs. The Navy continued to integrate components of the GENISYS, which enables energy command and control, providing real-time situational awareness of the energy demand associated with equipment onboard, as well as updated fuel budgeting, tracking, and planning tied directly to ship operations. In FY 2018, Navy continued to provide multiple vendors of Solid State lighting options in the stock system to drive down the cost of lighting. The Navy continued Stern Flap installs on guided missile cruisers and destroyers and certain amphibious ships (LHD, LPD, LSD).
- Energy in Aviation – In FY 2018 the Aircraft Energy Program initiated the development of a high fidelity F-18 fuel consumption dashboard and analysis tool based on aircraft generated data. The Navy also continued investments in multiple programs to increase operational capability through the development of more efficient platforms. Those include the trim-optimizing flight control algorithm for the F/A-18, recuperator technology on unmanned systems, and performance improvements to the F414 engine of the F/A-18E/F Super Hornet.
- Training and Education – The Navy seeks to ensure current and future operators and commanders understand operational energy requirements, and incorporate the requisite

actions to balance demand and supply in the operating environment. To provide that knowledge to the warfighter, the Navy's Operational Energy Training and Education plan is integrating operational energy concepts into tasks, doctrine, and policy, and throughout the Navy's Training and Education continuum. In FY 2018, the Navy developed and submitted revisions to Navy Tactical Tack Lists and Joint Logistics planning publications to include operational energy. Further, the Navy continued offering an Energy General Military Training (GMT), and offers four master's degree programs with an energy focus at the Naval Postgraduate School.

- Fuel Testing and Certification – The Navy continues to assure that its tactical platforms (air, sea and ground) remain compatible with the continually evolving changes in fuel, refining processes, and commercial specifications. In support of this goal the Navy: (1) developed multiple laboratory analytical techniques to measure the complex chemical composition of its tactical fuels, (2) conducted hardware testing to evaluate the impact fuel chemistry and properties have on platform performance and (3) initiated the development of an advanced data analysis tool to rapidly compile, analyze and develop predictive capabilities derived from multiple diverse sources.

In FY 2019, Navy anticipates continuing research and development to support pulse weapons on ships, initiate R&D in efforts to solve ship to shore fuel movement in support of distributed joint operations, and focus our analytic agenda on Indo-Pacific theater operations.

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.

In FY 2018, the Marine Corps continued to evaluate operational energy risk using modeling and simulation to assess OPLANs and defense planning scenarios. This growing body of energy risk analyses confirms and quantifies the gaps being addressed in the Marine Corps capability development process.

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 the Office of the Secretary of Defense.

The following specific initiatives highlight the Marine Corps' operational energy accomplishments in FY 2018:

- The Marine Corps is continuing to team with the Army with the fiscal support of OSD's OECIF 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. While previous demonstration efforts focused on maneuver units and individual vehicles, the FY 2018 efforts refined the focus to bulk fuel storage and distribution assets as visibility and understanding of bulk fuel enables more effective usage of energy. JOEC2 is transitioning from a technology demonstration to a program of record in FY 2019 with the drafting of a Capabilities Development Document for insertion into the Joint Capabilities Integration and Development System (JCIDS).
- In FY 2018, the Marine Corps conducted multiple technology demonstration efforts in support of the Mobile Amphibious Assault Fuel Distribution (MAAFD) experimentation program. These demonstrations are assessing mitigation options for the ship-to-shore bulk fuel distribution and expeditionary fuel capability 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. Demonstration efforts included novel bulk fuel storage and delivery methods utilizing the Navy Improved Naval Lighterage System and Supervisor of Salvage dracones as representative fuel barges to assess at-sea storage and movement of fuel from ship-to-shore.
- MAAFD also successfully demonstrated expeditionary systems that can additize commercial fuel to meet DoD specifications. This Expeditionary Mobile Fuel Additization Capability (EMFAC) will be deployed to meet the requirements of an Urgent Universal Needs Statement submitted by the operating forces. In addition to the EMFAC MAAFD demonstrated an expeditionary system that provides the equipment to tap into a fuel source and create a two-spot fueling point for aircraft. MAAFD is focused on conducting ascending levels of demonstrations in FY 2019 culminating with the Marine Corps Warfighting Laboratory's MAGTF Large Scale Exercise in FY 2020.

The Marine Corps has developed 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 2019.

Finally, the Marine Corps adapted 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. In FY 2018, the Marine Corps worked closely with the MOTOR-T Formal Learning Center to integrate operational energy into the existing curriculum.

Navy and Marine Corps investments in operational energy enable a more lethal and resilient force with enhanced mission effectiveness that support increases in warfighting capability while reducing logistics risk. As new technologies such as directed energy weapons continue their development, the operational energy program ensures that these and other advanced weapons and capabilities that help support naval maneuver are supported. The DONs Energy programs incorporation of technological advancements, cultural and behavioral changes to energy usage, and greater analytic based decisions will enable a more lethal force.

Combatant Commands

OASD(S) 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:

- Indo-Pacific Command (INDOPACOM). INDOPACOM coordinated with ODASD(Energy) 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(Energy) has provided an Operational Energy advisor to CENTCOM to increase knowledge of operational energy concepts and champion operational energy-related issues to include increased reach and resilience of forces operating in the AOR. CENTCOM closely coordinated with their Component, Army Central (ARCENT), to develop a power resilience framework. In partnership with ARCENT and ODASD(Energy) office, provided foundational language to the Components establishment of their Resource Efficiency Manager Program (eREM). CENTCOM also revised their Theater Campaign Plan to reflect the importance of operational energy in support of ongoing Counter-Insurgency Operations
- Africa Command (AFRICOM). AFRICOM coordinates with ODASD(Energy), Rapid Innovation Fund (RIF), National Defense Center for Energy and Environment

- (NDCEE), and the Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL) to develop innovative technology to reduce fuel consumption in field operations. AFRICOM is developing this technology by collaborating with RIF and NDCEE to fund three hybrid battery storage prototypes for field operations. AFRICOM partners with Project Manager Expeditionary Energy and Sustainment Systems (PM E2S2) on the feasibility of installing micro-grid systems at posture locations in Africa.
- European Command (EUCOM). In partnership with OASD(S), EUCOM is evaluating the operational energy requirements for US Forces, Allies, and Partners across the deliberate planning process. In collaboration with OASD(S), the Command, their Components and Federally-funded research and development centers (FFRDCs) are assessing the operational energy requirements to support the planned scheme of maneuver.

Conclusion

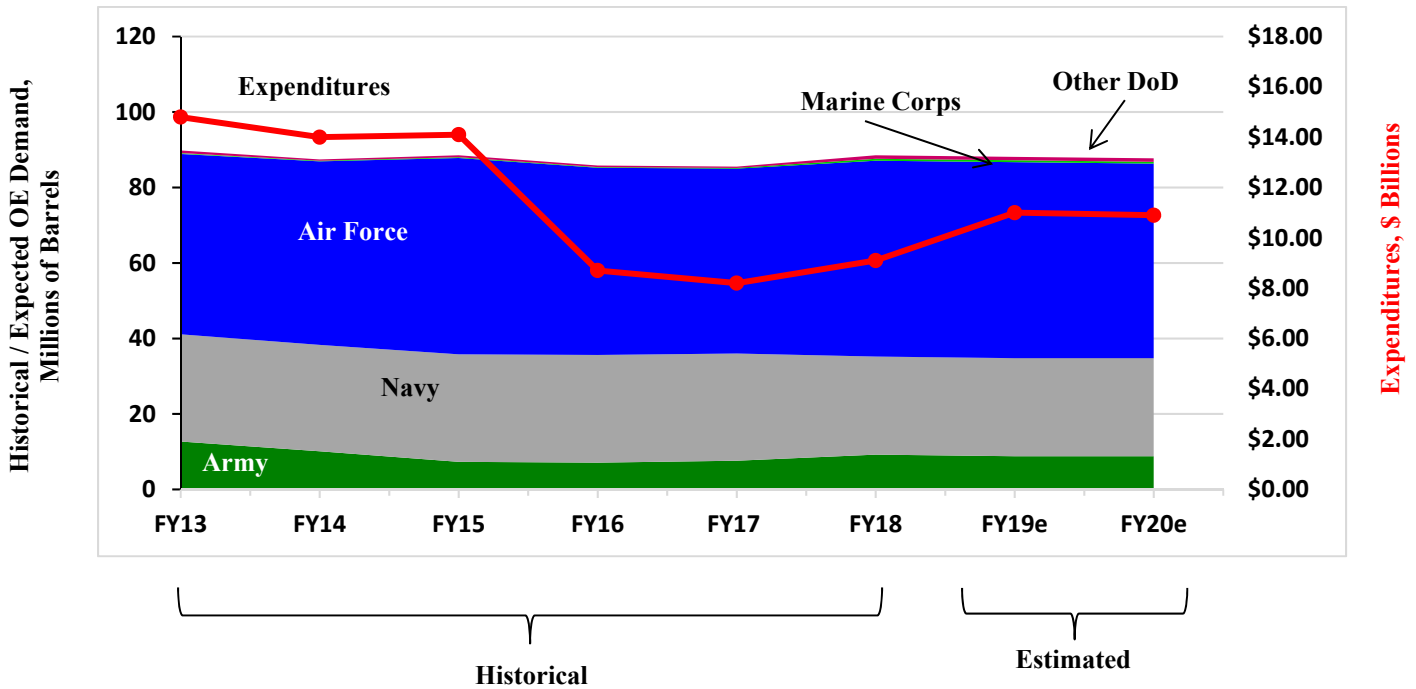
The *National Defense Strategy* (NDS) outlines a challenging operating environment and specifies the need to enhance “forward force maneuver and posture resilience” and “resilient and agile logistics” in contested environments. As a result, the Department will need to think differently about how we will 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 2019, the Department and Services will focus on the goals of the NDS through resilient fuel infrastructure and agile logistics and sustainment. 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 2013–2018, estimated demand for operational energy in FY 2019-2020, 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 2019 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.⁴

Figure 1: DoD Operational Energy Demand, FY 2013 – FY 2020e⁵



⁴ Standard DLA Energy fuel prices can be found at <http://www.dla.mil/Energy/Business/StandardPrices.aspx>

⁵ 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

		FY13	FY14	FY15	FY16	FY17	FY18	FY19e	FY20e
Operational Energy Demand, Million Barrels	Army	12.7	10.1	7.3	7.1	7.6	9.2	8.8	8.8
	Navy	28.4	28.2	28.5	28.5	28.4	26.0	26.0	26.0
	Air Force	47.8	48.6	52.0	49.6	49	51.9	51.9	51.5
	Marine Corps	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.5
	Other DoD	0.7	0.3	0.5	0.4	0.3	0.9	0.9	0.9
	<u>Total Demand</u>	89.8	87.4	88.6	85.7	85.5	85.4	88.1	87.6
	<u>Expenditures (\$ Billions)</u>	\$14.8	\$14.0	\$14.1	\$8.7	\$8.2	\$9.1	\$11.0	\$10.9

1 **Appendix B: Alternative Fuels Initiatives**

2
3 **Testing and Evaluation:** Testing and evaluation of all fuel including alternative fuels is
4 essential for DOD readiness. DoD alternative fuels activities include testing and evaluating,
5 production, and procurement. The Department understands that drop-in alternative fuels—fuels
6 produced from feedstocks other than petroleum—may be comingled into the commercial fuel
7 supply chain the military relies on, may be available in locations where petroleum fuel supplies
8 are scarce, and/or may have characteristics that alter performance and/or maintainability of
9 military platforms. As a result, the DoD’s FY 2018 alternative fuels RDT&E investments
10 predominantly focused on test and evaluation (T&E) in support of the qualification and
11 certification of fuels produced through new alternative fuel pathways.

12
13 In FY 2018, subject matter experts from the Army, Navy, Air Force, and DLA Energy
14 continued to support and complement drop-in alternative fuel T&E work sponsored by the
15 Federal Aviation Administration (FAA), ASTM International, and the Commercial Aviation
16 Alternative Fuels Initiative (CAAFI). One major initiative led by the FAA is the National Jet
17 Fuels Combustion Program (NJFCP), an interagency and commercial industry group focused on
18 developing and improving combustion models that enable new alternative fuels to be more easily
19 screened and qualified for aviation fuel specifications. Much of the work for NJFCP takes place
20 at the Air Force Research Laboratory (AFRL) with funding from outside sources. The Military
21 Services’ (DoD-funded) certification and qualification programs are coordinated through the Tri-
22 Service Petroleum, Oils, and Lubricants Users Group (TRIPOL), which reviews data from
23 ASTM International and equipment manufacturers. This review then informs the DoD’s
24 airworthiness authorities on the decision to review and approve a new fuel pathway given the
25 existing available data, or to invest in supplemental fuel evaluation and data collection on a new
26 fuel pathway. The primary FY 2018 activities of the Military Services, as presented in **Tables 3**
27 **and 4**, include:

- 28
29
- 30 • Army: For ground platforms, the Army continued to support the T&E of
31 alternative jet fuel pathways that have been (or are expected to soon be) approved
32 by ASTM International. For air platforms, the Army has not funded T&E of
33 alternative jet fuels since FY 2014.
 - 34 • Navy: For aviation and sea platforms, the Navy continued T&E of drop-in
35 alternative fuel pathways for potential inclusion in the specifications for JP-5 and
36 F-76 fuels, both of which are managed by the Navy. In September 2017, the
37 Navy updated the fuel specification for F-76 to permit up to 20 percent blends of
synthetic isoparaffin, as presented in **Table 3**.

- 1 • Air Force: Other than providing in-kind and work-for-others support for
2 international and interagency alternative jet fuel T&E initiatives, the Air Force
3 has not funded alternative jet fuel T&E since FY 2013.
- 4 • DLA Energy: DLA Energy's Energy Readiness Program (ERP) provided partial
5 funding for AFRL's work in support of the NJFCP.
6

7 Production Capacity: In the fall of 2014, three \$70 million Defense Production Act Title III
8 Phase 2 awards were announced for the construction of facilities capable of producing at least 10
9 million gallons per year of MILSPEC biofuels. The source of funds for these awards included
10 FY 2012 and FY 2013 funding from OSD and Navy, respectively, and additional funding from
11 the DOE. On October 27, 2017, Fulcrum Sierra Biofuels reached financial close (required to
12 commence Phase 2), after having already completed and operated their feedstock (municipal
13 solid waste) processing facility at full capacity in 2017. On December 27, 2017, Red Rock
14 Biofuels also reached financial close. Both companies broke ground for construction in the
15 spring of 2018, and are expected to achieve routine fuel production by the end of 2020. The
16 third company offered a Phase 2 award, Emerald Biofuels, did not achieve financial close by the
17 end of 2017, and its contract award was terminated for default. In addition, a \$55 million
18 solicitation for additional biofuel procurement was cancelled in FY 2018.

19 Procurement: Through statute and policy, drop-in alternative fuels procured for use in operations
20 are purchased when compatible with existing equipment and infrastructure and cost-competitive
21 with traditional fuels. The Department's solicitations for bulk fuels provided in or after FY 2016
22 have been open to fuels that include blends of alternative fuel pathways consistent with the fuel
23 specifications presented in Table 5. Approximately three years after the first bulk fuel contract
24 award that incorporated blends of drop-in alternative fuels, DLA-Energy made a third such
25 award in July 2018. This award was made to AltAir Paramount in California to supply F-76 that
26 may contain bio-based hydroprocessed esters and fatty acids (HEFA) fuel, which is derived from
27 renewable fats, oils, and greases. The 2018 contract, was a \$103 million award for supply of 54
28 million gallons of F-76 at a price of \$1.912/gallon, to be supplied between October 1, 2018 and
29 September 30, 2019.

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 2018 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 Systems⁶
(Dollars in Thousands)

Service	Program Title	Initiative Title	Description	Treasury Code (TC)	Budget Activity (BA)	Budget Line Item	Program Element (PE)	FY 2018 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 ⁷
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 Directorate – 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	500
Subtotal								1,881
Total Expenditure in FY 2018								2,827

⁶ These initiatives include the procurement of alternative fuels to support testing and evaluation activities.

⁷ 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	
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) was established in FY 2012, and ODASD(OE) had oversight through FY 2018. Effective 1 November 2018, OECIF transitioned to the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) as part of the broader reorganization of the former Office of the Under Secretary of Acquisition, Technology, and Logistics.

The purpose of OECIF is to act as “seed money” to develop and integrate operational energy technologies that improve the Department’s operational effectiveness. OECIF projects historically have received four years of funding. Once OECIF funding is exhausted, continued funding for the project shifts to the identified transition partner(s), which is generally the Services, Combatant Commands or the Office of the Secretary of Defense (OSD).

OECIF is executed as a Research, Development, Test, and Evaluation Program Element, Budget Activity 3 (Advanced Technology Development) appropriation (“6.3”).⁸ OECIF generally supports projects that aim to mature operational energy technologies with Technology Readiness Level (TRL) values ranging from 4 to TRL 6.

OECIF projects have been selected annually from Military Service and Combatant Command proposals that align with the National Defense Strategy (NDS), the Department’s *Operational Energy Strategy*, and that support the fiscal year’s OECIF theme. OECIF annual themes have reflected Departmental priorities, capability gaps, and challenges which shape science and technology (S&T) investments.

Since FY 2012, OECIF has funded over 70 projects across a range of specific operational themes, as shown in Table 6. Of the 42 projects that have closed, 31 were considered successful from a technical and transition perspective (74% transition rate). Seven projects lack sufficient documentation to assess transition (many of these occurred as demonstrations in Afghanistan during Operation Enduring Freedom). Four projects were terminated. Lessons learned from the terminated projects continue to provide useful operational energy insight across the community.

In FY 2018, OECIF funding supported several one year studies to identify operational energy S&T gaps in the near-, mid-, and far-term. Each study delivers an S&T roadmap and provides analytically underpinned capability gaps to support potential future OECIF calls for proposals.

⁸ 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).

Projects completed in FY 2018 began in FY2014 under the “Developing operational energy analytical methods and tools” theme. This OECIF investment was made to ensure legal compliance and to enhance acquisition milestone decisions. These projects and their accomplishments include:

- Operational Energy Analysis Task Force (OEATF) enhanced the Fully Burdened Cost Tool, upgraded the Logistics Battle Command Model, performed verification and validation of the Shelter Thermal Energy model, and produced a web-based prototype for expeditionary basing OE analysis. This effort developed tools that assess OE impact on mission effectiveness and identify mitigation approaches for addressing shortcomings in data development, scenarios, methods, models, and tools. Transition has occurred throughout the Army to organizations including the Training and Doctrine Command (TRADOC), Army Materials Systems Analysis Activity (AMSAA), and the Ground Vehicles System Center (GVSC). The Army now has a foundational capability to meet 10 U.S. Code § 2925 (b) (2) (F).
- The Capability Assessment and Modeling for Energy Logistics (CAMEL) project developed a modeling and simulation tool to evaluate the impacts of advanced technologies and logistic variables on the campaign war fight and to assess their impact on operational energy consumption. It introduces energy delivery, resiliency, and security into operational planning while characterizing potential threats to future operations. CAMEL's advanced aerial refueling capabilities concepts project has transitioned to the Air Force Life Cycle Management Center (AFLCM), and the Strategic Development Planning and Experimentation (SDPE) office has pledged funds to support continued use moving forward. The Air Force now has a foundational capability to meet 10 U.S. Code § 2925 (b) (2) (F).

Table 6. OECIF Programs, FY 2012-18

Start Year	Theme	Projects Funded
FY 2012	Reducing energy load at expeditionary outposts	8
FY 2013	Using consortia to attack key operational energy problems	6
FY 2014	Developing operational energy analytical methods and tools	7
FY 2015	Improving fuel economy for the current tactical ground fleet	14*
FY 2016	Increasing the operational energy performance of unmanned systems	14*
FY 2017	1) Thermal and power management technologies for high pulse power systems 2) Wireless transmission of energy in the far-field	15*
FY 2018	One-year studies to identify operational energy science and technology gaps in the near-, mid-, and far-term	9*
FY 2019	Enhanced Energy Storage for Autonomous Systems Nuclear Fuel & Reactor Study effort	12*

* Includes projects funded with a Congressional plus-up; topics vary

- Maritime Prescreening Assessment for Conservation Technologies (M-PACT) established a test bed to evaluate performance-improving commercial off the shelf (COTS) energy technologies at sea. Naval Surface Warfare Center (NSWC) Carderock partnered with the Department of Energy's National Renewable Energy Laboratory (NREL) and the Department of Transportation (DOT) Maritime Administration Academies to develop and install a sensor suite for energy baselining and future COTS performance evaluations which leads to more rapid acquisitions and fielding. In addition to the sensor suite, the OECIF project funded a variable refrigerant flow cooling system on the Massachusetts Maritime Academy's training ship, the TS Kennedy. The Navy has transitioned this working test bed. Chief of Naval Operations staff (OPNAV), the office of the Director of Innovation, Technology Requirements and Test & Evaluation (N94) has provided long term funding as part of their POM 21 submission. The first N94 funded experiments are planned in support of Waste Heat Recovery and Bio-fowling.

Two projects from within the FY14 theme were scheduled to end this year but were given no-cost extensions: STORM-E and J-DEPLOI. Both have spiral development efforts and transition as they go.

- The Synthetic Theater Operations Research Model - Energy (STORM-E) project is a modeling and simulations effort that inserts campaign-level energy analysis into the Department's premier campaign simulation model. The goal is to ensure operational energy becomes a default analytic consideration during campaign planning. STORM-E's modifications have successfully transitioned into the existing model, which is owned and maintained by HQ/US Air Force Studies, Analysis, and Assessments (HQ/USAF A9). These updates include modeling of OE storage build-ups, port operations, targetable airbase fuel hydrants, dynamic pipelines, explicit logistics support, improved logistics effects in existing units, air-to-air fuel burn, enhanced unit shortage effects, supply-vehicle energy consumption, ground alert close air support for aircraft and helicopters (energy impacts included), and airbase consumption. Current modifications are being made for support-unit consumption and on-going data development for the next Operational Plan / Scenario. The USMC conducts OE-informed analysis in support of 10 U.S. Code § 2925 (b) (2) (F).
- The Joint Deployment Energy Planning and Logistics Optimization Initiative (J-DEPLOI) effort is a planning tool that facilitates energy analyses earlier into the Joint Planning Process (JPP). Operational planners currently lack the ability to visualize, quantify, and collaboratively evaluate fuel logistical vulnerabilities during the JPP. This project allows planners to rapidly build and visualize fuel networks on geo-referenced maps during the development of Course of Action (COA) planning. Currently, J-

DEPLOI has transitioned to the Joint Planning Services (JPS) Program of Record (PoR) managed and sustained by the Army PM for Mission Command. Ongoing user events provide both training and refinements to the J-DEPLOI tool.

One additional project from FY13 has been given a no-cost extension. FY13 projects were designed to use consortia to address key operational energy problems. One such problem is the use of standards across the operational energy domain to facilitate interoperability, energy sharing, to increase industry competition, and to drive down acquisition and logistics life-cycle costs.

- The goal of the Tactical Micro-grid Standards Consortium (TMSC) is to use an industry consortium approach to develop open and joint standards for tactical micro-grids. The end product of this effort will be a Military Standard (MIL-STD) which enables interoperability of tactical micro-grid components, resolving the most significant impediment to widespread micro-grid implementation. This standard is currently being evaluated by the Lead Standards Agency for the Defense Standardization Program Office (DSPO). DSPO will then establish this document as a MIL-STD. Army Program Manager Expeditionary Energy Sustainment Systems (PM E2S2) will own and manage the final MIL-STD for DoD-wide procurement. Once published, it will be available for use in upcoming acquisitions such as the Squad Multipurpose Equipment Transport (SMET).

Five of seven FY14 projects have or are anticipated to transition with dedicated Service funding and use. One program was terminated and one program lacks sufficient documentation to assess.

In FY19, OECIF is funding projects that support Enhanced Energy Storage for Autonomous Systems, Space Solar Power Beaming to Forward Operating Bases (S2FOBs), and Nuclear Fuels / Reactors. All three topics share an overarching theme of extending the warfighter's ability project greater power on a dynamic battlefield with increased lethality.

The growing role of autonomous systems in warfare needs to be underpinned by the operational energy imperatives of enhanced platforms and weapons capabilities through better use of operational energy, improved distributed operations in an Anti-Access / Area Denial (A2/AD) environment, and improved safety. Moreover, the FY19 investments improve DoD business processes such that costs can be significantly reduced with the renewed focus on operational energy storage standardization.

In FY19, S2FOBs is focused on critical component technology advancement of solar collection, power beaming, and supporting technologies in the RF, laser, and millimeter spectrums. These efforts buy down risk for the larger FY20 projects.

The final FY19 OECIF topic highlights the administration's interest in Nuclear Fuels and Reactors and their potential role in resiliency and battlefield capabilities. Future mobile and modular nuclear reactors will require safer fuels. OECIF is supporting technology development and demonstration and also feasibility assessments.

Looking ahead to FY20, the next OECIF topic will be drawn from the operational energy community (Service Labs, Service Energy Offices, OSD, Combatant Commands, and Subject Matter Experts) informed by the gaps identified as part of the FY18 studies/projects. It will also advance technologies in support of S2FOBs.

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 2018 Operational Energy Initiatives (Dollars in Thousands)

Table 8. Air Force FY 2018 Operational Energy Initiatives (Dollars in Thousands)

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	1,606	125	981
USAF	Materials	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	02	0602102F	1,828	83	-
USAF	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	592,851	2,306,454

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	9,338	58,186
USAF	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	2,241	31,439
USAF	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	8,708	12,626	87,190
USAF	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	8,488	7,446	102,141

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	8,304	3,876	20,410
USAF	Aerospace Propulsion	Aircraft Thermal Systems	Technologies to improve thermal acquisition, transport and rejection	Increase Warfighter Capability	Platform Thermal Management	3600	02	0602203F	9,389	5,889	26,239
USAF	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	13,621	1,497	3,949
USAF	B-52H Re-Engine	B-52 Commercial Engine Replacement Program (CERP)	This sustainment program will replace the current unsustainable TF33 engine with engines of similar size, weight, and thrust characteristics. The development, production and installation of new engines and related subsystems will replace legacy equipment on 76 B-52H a/c.	Enhance Mission Effectiveness	Propulsion Upgrades_Air	3600	07	0101113F		10,000	1,459,200
USAF	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 Air Dominance and Next Generation Mobility.	Increase Warfighter Capability	Materials and Design	3600	03	0603199F	5,433	7,875	8,078
USAF	Aerospace Technology Development/ Demonstration	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 Generation Mobility.	Increase Warfighter Capability	Materials and Design	3600	03	0603211F	-	-	21,798
USAF	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 Generation Mobility.	Increase Warfighter Capability	Materials and Design	3600	02	0602201F	11,331	8,283	36,648

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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 Generation Mobility.	Increase Warfighter Capability	Materials and Design	3600	02	0602201F	7,653	5,932	13,324
USAF	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	02	0602102F	1,873	12	-
USAF	Advanced Materials for Weapon Systems	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	-	731	79
USAF	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	3,796	18,638
USAF	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	6,735	7,611	47,429

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	5,243	32,671
USAF	Aerospace Propulsion	Efficient Medium Scale Propulsion	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 EMSP Phase I 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. Additionally, development costs will be reduced.	Increase Warfighter Capability	Propulsion Upgrades_Air	3600	02	0602203F	2,459	1,685	52,743
USAF	Aerospace Propulsion and Power Technology	Efficient Medium Scale Propulsion	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 EMSP Phase I program 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	2,891	17,165
USAF	Aerospace Propulsion and Power Technology	Efficient Medium Scale Propulsion	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 EMSP Phase I program is to use a common commercial core engine, in the 5,000 to 1	Increase Warfighter Capability	Propulsion Upgrades_Air	3600	03	0603216F	-	-	24,213
USAF	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	2,373	691	31,171
USAF	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	0603216F	-	-	4,436

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	5,469	39,373
USAF	Aerospace Propulsion 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	1,219	10,972	5,492
USAF	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	4,190	21,616
USAF	Aerospace Propulsion 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	3,049	-	-
USAF	Defense Research Sciences	Energy, Combustion and Non-Equilibrium Thermodynamics	This portfolio addresses energy needs for propulsion systems and their supporting sub-systems. The portfolio emphasizes three key attributes: Fundamental, Relevant, and Game-Changing, focusing on establishing fundamental understanding and quantifying rate-controlling processes in Air Force relevant energy processes, leading to game-changing concepts and predictive capabilities in Air Force relevant regimes. Multi-disciplinary collaborations and interactions are strongly desired, and joint experimental, theoretical and numerical efforts are highly appreciated.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	8,174	7,819	48,722
USAF	Defense Research Sciences	Energy, Combustion and Non-Equilibrium Thermodynamics	MURI, DURIP, and PECASE efforts executed under the Energy, Combustion and Non-Equilibrium Thermodynamics program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	-	1,299	-
USAF	Materials	Enhanced Physics-based Prognosis and Inspection for CMCs (EPPIC)	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	-	4,575	14,013

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	2,481	2,403	15,134
USAF	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	5,578	34,757
USAF	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	4,502	4,616	29,355
USAF	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	2,262	2,302	14,794
USAF	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	6,708	41,797

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	2,456	-	-
USAF	Aerospace Propulsion	Integrated Vehicle Energy Tech (INVENT)	Develop an integrated suite of efficient, mission adaptive, robust electrical and thermal management systems to reduce aircraft energy demand	Increase Warfighter Capability	Platform Thermal Management	3600	02	0602203F	632	731	3,552
USAF	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	2,079	-
USAF	KC-135 C-PUP	KC-135 CFM-56 Propulsion Upgrade Program	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	-	429,562	2,571,338
USAF	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	-	1,572
USAF	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	03	0602201F	576	-	1,572
USAF	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	-	1,815
USAF	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. Such materials 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	7,395	7,003	43,640

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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 development and integration criteria, and thereby (c) to establish safer, more maneuverable aerospace vehicles and platforms with unprecedented performance characteristics.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	7,573	7,169	44,671
USAF	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	7,071	70,603
USAF	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	-	-	1,895
USAF	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	1,242	10,346	114,378
USAF	Materials	Modeling for Affordable, Sustainable Composites (MASC)	ICME tools will be applied toward the manufacturing and sustainment of affordable, lightweight composite materials for aircraft components.	Increase Warfighter Capability	Materials and Design	3600	02	0602102F	-	10,059	5,568

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	11,771	73,347
USAF	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	4,548	34,810
USAF	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	-	-	25,101
USAF	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	606	50,089

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	2,298	1,197	-
USAF	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	-	50	5,212
USAF	Advanced Materials for Weapon Systems	OMC Processing-to-Performance Evaluation Research and Analysis (OPPERA)	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	0603112F	-	-	67
USAF	Materials	OMC Processing-to-Performance Evaluation Research and Analysis (OPPERA)	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	-	-	16,049

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	7,406	46,147
USAF	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	11,004	10,838	67,533
USAF	Defense Research Sciences	Quantum Electronic Solids	Explores new superconductors, metamaterials, and on nanoscopic electronic devices with low power dissipation and the ability to provide denser non-volatile memory, logic and/or sensing elements.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	6,300	5,974	37,221

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	Defense Research Sciences	Space Power and Propulsion	Research activities are focused as multi-disciplinary, multi-physics, multi-scale approach to complex problems, and fall into four areas: Coupled Material and Plasma Processes Far From Equilibrium, Nanoenergetics, High Pressure Combustion Dynamics, and Electro Spray Physics.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	5,267	5,294	32,990
USAF	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	99	89	-
USAF	Aerospace Propulsion and Power Technology	Surfing Aircraft Vortices for Energy (\$AVE) Formation Flight Advanced Technology	This ATD will build upon the Surfing Aircraft Vortices for Energy (\$AVE) flight demonstration conducted on the C-17 Block 18 aircraft.	Enhance Mission Effectiveness	Current Operations Tools	3600	03	0603211F	607	-	-
USAF	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	8,021	1,263	724
USAF	Advanced Materials for Weapon Systems	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	03	0603112F	327	324	-
USAF	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	5,837	14,324
USAF	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	6,901	13,132
USAF	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	879	855

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	649	-
USAF	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	898	436
USAF	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	3,093	4,088
USAF	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	218	218
USAF	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	675	872
USAF	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	4,918	8,202
USAF	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	3,256	-
USAF	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	5,128	12,645
USAF	University Research Initiative	URI - Quantum Electronic Solids	MURI, DURIP, and PECASE efforts executed under the Quantum Electronic Solids program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	-	8803	15,913
USAF	University Research Initiative	URI - Space Power and Propulsion	MURI, DURIP, and PECASE efforts executed under the Space Power and Propulsion program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	-	2263	7,766

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	1,606	125	981
USAF	Materials	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	02	0602102F	1,828	83	-
USAF	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	592,851	2,306,454
USAF	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	9,338	58,186
USAF	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	2,241	31,439

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP
USAF	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	8,708	12,626	87,190
USAF	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	8,488	7,446	102,141
USAF	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	8,304	3,876	20,410

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BA Code	Program Element	FY 2017	FY 2018	FYDP

Table 9. Army FY 2018 Operational Energy Initiatives (Dollars in Thousands)

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	In-house Laboratory Independent Research	Advanced Mobility - ILIR - TARDEC 02	TARDEC inhouse basic research research for ground vehicles to support improved system mobility, reliability, and survivability	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	01	0601101A	1350	1301	6317
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	4220	3460	18186
ARMY	Defense Research Sciences	Research In Vehicle Mobility 01	Basic researchin 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	718	735	3822
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	4203	4467	14390
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	0	1776	6981
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	6726	3811	20483
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	3108	3164	17941
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	3500	3500	19846
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	2678	1557	10047

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	3362	4391	22548
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	5436	5598	21635
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	1498	2421	2421
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	237	1301	9865
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	1360	1384	2778
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	0	0	3431
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	1405	1450	1450
ARMY	Combat Vehicle and Automotive Technology	Energy Storage Research STO 87SV	Grpund vehicle applied research in energy storage	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602601A	1070	1070	3606
ARMY	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research 88	Ground vehicle applied research in auxilliary power unit technology.	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602601A	0	0	2354

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research 88I	Ground vehicle applied research in auxilliary power unit technology.	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602601A	619	630	1264
ARMY	Combat Vehicle and Automotive Technology	Ground Vehicle APU Research STO 88V	Ground vehicle applied research in auxilliary power unit technology.	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602601A	679	697	697
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	0	246	3019
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	1288	504	822
ARMY	Combat Vehicle and Automotive Technology	Next Generation Engine Research 90	Ground vehicle applied research ina high power density low heat rejection, fuel efficient engine technology.	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	02	0602601A	0	0	12168
ARMY	Combat Vehicle and Automotive Technology	Next Generation Engine Research STO 90V	Ground vehicle applied research ina high power density low heat rejection, fuel efficient engine technology.	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	02	0602601A	2920	2973	5965
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	0	0	9373
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	2975	3493	6496
ARMY	Combat Vehicle and Automotive Technology	Vehicle Electrification Research 98	Ground vehicle applied research in electrical distribution.	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602601A	0	0	6000
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	2364	2016	15235

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	1100	1000	2000
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	1504	1500	1500
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 poweruse in current and future platform sub-systems, vehicle, and micro-grid (installation) applications.	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602705A	2102	1667	9648
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	4034	3609	6555
ARMY	Electronics and Electronic Devices	Energy Informed Operations Technologies 07T	Applied research for tactical power generation, control, and distribution technology to enable flexible intelligent power for mobile command post operations	Increase Warfighter Capability	Contingency Basing	2040	02	0602705A	2932	3293	22914
ARMY	Electronics and Electronic Devices	ExMC STO-D - Energy Informed Operations 09	Applied research for tactical power generation, control, and distribution technology to enable flexible intelligent power for mobile command post operations	Increase Warfighter Capability	Contingency Basing	2040	02	0602705A	0	1430	1430
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	887	4630
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	1385	1409	8309
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	250	400
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	1202	1110	4087
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	2524	2750	15275
ARMY	Electronics and Electronic Devices	Energy Efficient Electronic Components 84	Applied research in reduced power electronics	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A	5023	5511	25723

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	Electronics and Electronic Devices	Technologies for Alternative Energy 90	Applied research in alternative energy sources	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602705A	0	1169	6102
ARMY	Warfighter Technology	Expeditionary Mobile Base Camp Technologies 04	Applied research for mobile base camps	Increase Warfighter Capability	Contingency Basing	2040	02	0602786A	0	3240	3240
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	2359	2482	15012
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	1013	2262	14362
ARMY	Aviation Advanced Technology	Alternative Concept Engine 07	Advanced technology demonstraton 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	4947	4044	19182
ARMY	Aviation Advanced Technology	Reliable Advanced Small Power Systems 08	Advanced technology demonstraton of power system technologies through design, fabrication, and evaluation of advanced engine components in order to improve the performance of small engines for USA	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	03	0603003A	0	2053	12281
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	0	2980	12906
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	0	2500	10271
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	0	2700	9158
ARMY	Combat Vehicle and Automotive Advanced Technology	Alternative Fuels and Petroleum, Oil & Lubricants 51	Ground vehicle alternative fuels and petroleum, oil & lubricants adanced technology development	Increase Warfighter Capability	Platform Upgrades_Land	2040	03	0603005A	273	2049	10608
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	0	0	15629

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	5000	5000	9793
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	0	0	4900
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	997	609	1133
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	1100	1100	2200
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	953	1405	2918
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	0	0	8860
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	3248	2815	5653
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	1086	1347	1347
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	0	0	5500

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	Combat Vehicle and Automotive Advanced Technology	Powertrain/Energy Storage/Survivability Demonstrator (OE) DOEZ	Advanced technology demonstration of combat vehicle powertrain and energy storage	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	03	0603005A	0	0	26428
ARMY	Combat Vehicle and Automotive Advanced Technology	Powertrain/Energy Storage/Survivability Demonstrator STO DTAV	Advanced technology demonstration of combat vehicle powertrain and energy storage	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	03	0603005A	7808	7300	14023
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	5200	5200	7460
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	1136	1176	13244
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	1038	1667	3344
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	987	974	11411
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	1945	1933	3880
ARMY	Combating Terrorism, Technology Development	AVPTA AVP	Conducts Ground Vehicle Power Technology efforts with DoE	Increase Warfighter Capability	Platform Upgrades_Land	2040	03	0603125A	5249	5340	27507
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	1304	1195	2268
ARMY	Combating Terrorism, Technology Development	Powertrain/Energy Storage/Survivability Technology DRLZ	Advanced technology demonstration of combat vehicle powertrain and energy storage	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	03	0603125A	3696	2805	2805

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	1500	1500	1500
ARMY	Advanced Medium Mobile Power Source (AMMPS)	Advanced Mobile Medium Power Sources (AMMPS) Generator Sets	Purchase of the improved medium generator sets using 21% less fuel	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A	92335	87955	349634
ARMY	Aviation Combined Arms Tactical Trainer (AVCATT)	Aviation Simulator	Simulators for aviation asset collective training	Enhance Mission Effectiveness	Training and Education	2040	05	0604780A	2769	5388	26770
ARMY	Aviation Combined Arms Tactical Trainer (AVCATT)	Aviation Simulator	Simulators for aviation asset collective training	Enhance Mission Effectiveness	Training and Education	2035	03	0219900A	40000	27293	149239
ARMY	Battlefield Kitchen	Improved Energy Efficiency	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Increase Warfighter Capability	Materials and Design	2040	05	0604713A	1295	2931	6703
ARMY	Battlefield Kitchen	Improved Energy Efficiency	Energy efficient burners and appliances save 20% in fuel vs. legacy appliances	Increase Warfighter Capability	Materials and Design	2035	03	0216300A	0	0	22045
ARMY	Contingency Base Infrastructure (CBI)	Contingency Base 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	3609	3946	19817
ARMY	Early Entry Fluid Distribution System (E2FDS)	More efficient fuel/non-potable water distribution	More efficient fuel/non-potable water distribution in the battlespace	Reduce Logistics Risks to Mission	Fuel Infrastructure	2040	04	0603804A	3027	2985	2985
ARMY	Early Entry Fluid Distribution System (E2FDS)	More efficient fuel/non-potable water distribution	More efficient fuel/non-potable water distribution in the battlespace	Reduce Logistics Risks to Mission	Fuel Infrastructure	2040	05	0604804A	2001	2985	2985
ARMY	Early Entry Fluid Distribution System (E2FDS)	More efficient fuel/non-potable water distribution	More efficient fuel/non-potable water distribution in the battlespace	Reduce Logistics Risks to Mission	Fuel Infrastructure	2035	03	0216300A	748	5706	47243

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	Expeditionary Water Packaging System (EWPS)	Reduced reliance on shipping water into theater	EWPS provides localized production of bottle water	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A	3582	3116	9523
ARMY	Force Provider	Improved Energy Efficiency	Base Camp Integration Lab (BCIL), Fort Devens / Net Zero / Zero Footprint	Enhance Mission Effectiveness	Contingency Basing	2040	04	0603804A	4151	3981	14271
ARMY	Force Provider	Improved Energy Efficiency	Base Camp Integration Lab (BCIL) Fort, Devens / Net Zero / Zero Footprint	Enhance Mission Effectiveness	Contingency Basing	2040	05	0604804A	2975	2243	19270
ARMY	Force Provider	Improved Energy Efficiency	Modifications to In-Service Equipment, Force Provider MoD 7 - Purchase of liners, shades, doorways, micro-grids and Light Emitting Diodes (LED) lighting resulting in a 35% reduction in fuel demand.	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A	16454	6881	39015
ARMY	Improved Abrams	Combat Vehicle Improvement	More efficient Abrams - Research & Development effort to improve Abrams fuel efficiency by 21%.	Enhance Mission Effectiveness	Platform Upgrades_Land	2040	07	0203735A	105	70	130
ARMY	Improved Abrams	Combat Vehicle Improvement	Advanced Reliability & Cost Savings (ARCS) for the AGT-1500 Turbine engine	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2033	01	0211702A	4250	3200	3500
ARMY	Abrams Upgrade Program	Combat Vehicle Improvement	Advanced Reliability & Cost Savings (ARCS) Hardware	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2033	01	0211702A	0	0	4060
ARMY	Improved Bradley	Combat Vehicle Improvement	More efficient Bradley - Research and Development effort to improve Bradley fuel efficiency by 3%	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2040	07	0203735A	100	100	100
ARMY	Improved Bradley	Combat Vehicle Improvement	Increases mobility with extended life track, and improved shocks, road arms and torsion bars	Enhance Mission Effectiveness	Platform Upgrades_Land	2033	01	0211702A	42800	61400	197000
ARMY	Improved Bradley	Combat Vehicle Improvement	More efficient Bradley - The Bradley improved transmission generate an overall fuel reduction of 3%	Increase Warfighter Capability	Propulsion Upgrades_Land	2033	01	0211702A	24300	58700	291200
ARMY	Improved Environmental Control Unit (IECU)	Improved Energy Efficiency	Heaters and Improved Environmental Control Unit (IECU) family	Enhance Mission Effectiveness	Contingency Basing	2040	05	0604804A	1259	1951	12482
ARMY	Improved Environmental Control Unit (IECU)	Improved Energy Efficiency	Heaters and Improved Environmental Control Unit (IECU) family	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A	17707	7405	88885
ARMY	Improved Power Distribution Illumination Systems Electrical (IPDISE)	Improved Energy Efficiency	More efficient power distribution	Enhance Mission Effectiveness	Contingency Basing	2040	04	0603804A	3000	1900	30100

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	Improved Power Distribution Illumination Systems Electrical (IPDISE)	Improved Energy Efficiency	More efficient power distribution	Enhance Mission Effectiveness	Contingency Basing	2040	05	0604804A	6800	12900	46700
ARMY	Improved Power Distribution Illumination Systems Electrical (IPDISE)	Improved Energy Efficiency	More efficient power distribution	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A	4350	10155	115043
ARMY	Improved Turbine Engine Program (ITEP)	Improved Aircraft Engine	More efficient helicopter engine - ITEP enters Milestone A in 4QFY16 - 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	116100	204300	1224020
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	0	0	192
ARMY	Joint Operational Energy Initiative (JOEI)	Modeling and Simulation	Holistic approach to the evaluation of Operational Energy related impacts, systems and improvements	Enhance Mission Effectiveness	M&S, Studies, and Wargames	2040	04	0603804A	1000	1000	2000
ARMY	Large Advanced Mobile Power Sources (LAMPS)	Improved Large Generator	Large Advanced Mobile Power Sources (LAMPS)	Enhance Mission Effectiveness	Contingency Basing	2035	03	0216300A	15328	16278	71341
ARMY	Modular Fuel System (MFS)	Modular Fuel System (MFS)	More efficient fuel distribution in the battlespace	Enhance Mission Effectiveness	Fuel Infrastructure	2035	03	0216300A	12803	11610	84402
ARMY	Nett Warrior	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	2035	03	0211700A	3493	6329	28138
ARMY	Simulator for the Apache helicopter	Aviation Simulator	Simulator for the Apache Helicopter	Enhance Mission Effectiveness	Training and Education	2031	01	0210100A	12940	13200	75560
ARMY	Simulator for the Blackhawk Helicopter	Aviation Simulator	The Blackhawk simulator saves fuel and enhances safety	Enhance Mission Effectiveness	Training and Education	2031	01	0210101A	0	0	62999
ARMY	Simulator for the Blackhawk Helicopter	Aviation Simulator	The Blackhawk simulator saves fuel and enhances safety	Enhance Mission Effectiveness	Training and Education	2031	01	0210101A	0	11300	11300

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	Simulator for the Chinook Helicopter	Aviation Simulator	Chinook Transportable Flight Proficiency Simulator saves (TFPS)	Enhance Mission Effectiveness	Training and Education	2031	01	0210104A	13980	17906	85185
ARMY	Simulator for the Chinook Helicopter	Aviation Simulator	Chinook Transportable Flight Proficiency Simulator saves (TFPS)	Enhance Mission Effectiveness	Training and Education	2040	07	0210104A	0	28840	36740
ARMY	Small Tactical Electrical Power (STEP)	Improved Small Generator	Small Tactical Electrical Power (STEP)	Increase Warfighter Capability	Contingency Basing	2040	04	0603804A	2000	4500	8500
ARMY	Small Tactical Electrical Power (STEP)	Improved Small Generator	Small Tactical Electric Power (STEP)	Increase Warfighter Capability	Contingency Basing	2035	03	0216300A	1300	1285	93423
ARMY	Small Unit Power - 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	0	6949	12557
ARMY	Small Unit Power - Squad Power Manager (SPM)	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	0	0	1323
ARMY	Small Unit Power - 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	0	1731	8405
ARMY	Small Unit Power - Platoon Power Generation	Small Unit Power (SUP) Platoon Power Generation	Platoon Power Generation	Enhance Mission Effectiveness	Individual/Warfighter Power	2040	05	0604827A	2300	6568	16039
ARMY	Small Unit Power - Platoon Power Generation	Small Unit Power (SUP) Platoon Power Generation	Platoon Power Generation	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A	0	0	17173
ARMY	Small Unit Power - 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	2035	03	0211700A	0	7370	130930

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
ARMY	Small Unit Power - 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	2035	03	0211700A	0	3086	39986
ARMY	Stryker	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network.	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2040	07	0202123A	46100	18800	20200
ARMY	Stryker	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2033	01	0202123A	0	0	1569600
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	104293	121504	803659
ARMY	Abrams Upgrade Program APU	Combat Vehicle Improvement	Auxiliary Power Unit	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2033	01	0211702A	900	1400	9300

Table 10. Marine Corps FY 2018 Operational Energy Initiatives (Dollars in Thousands)

ORC	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
USMC	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	0203761M	0	501	3218
USMC	Advanced Power Sources	GREENS/MEHPS	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	06	0206211M	11300	1425	56714

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
USMC	Advanced Power Sources	MEHPS	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	06	0502511M	3180	1784	9392
USMC	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	0206624M	1	1	5
USMC	Advanced Power Sources	Next Generation SPACES, GREENS	Advanced Power Sources is a family of small power devices to provide portable electric power for legacy and future weapons, optics, sensors, medical, 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	07	0206624M	854	871	10494

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
USMC	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	03	0804771M	103	105	545
USMC	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 least 15% fuel efficiency improvement over the existing MTRV.	Increase Warfighter Capability	Individual/Warfighter Power	1319	03	0603640M	5000	9501	46215
USMC	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	0602131M	2450	2950	14596
USMC	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.	Increase Warfighter Capability	Contingency Basing	1319	07	0206624M	262	507	2648
USMC	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	0206315M	0	0	2481
USMC	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	0206624M	57	62	335

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
USMC	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	0502514M	18	1401	13774
USMC	Expeditionary Energy Office	Expeditionary Energy Concepts (E2C, formally ExFOB)	Semi-Annual process to evaluate and deploy technologies to support Marine Corps Expeditionary Energy Strategy goals of increased combat effectiveness and reduced dependence on liquid logistics on the battlefield.	Increase Warfighter Capability	Individual/Warfighter Power	1319	07	0206313M	2159	2199	11446
USMC	Expeditionary Energy Office	Expeditionary Energy Office	USMC Senior Official for Operational Energy, Plans and Programs. Tasked by CMC to Analyze, develop, and direct the Marine Corps' energy strategy in order to optimize expeditionary capabilities across all Warfighting functions.	Increase Warfighter Capability	Individual/Warfighter Power	1106	04	0903798M	0	3451	15236
USMC	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	0206623M	130	286	1188
USMC	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	0206211M	0	0	52816
USMC	Medium Tactical Vehicle Replacement (MTVR)	Fuel Efficient MTVR FNC Transition	Through analysis, modeling and simulation, hardware development, integration, test, and evaluation, the Fuel Efficient Medium Tactical Vehicle Replacement (MTVR) FNC program will select, bench test, and integrate a suite of affordable fuel efficiency enablers.	Enhance Mission Effectiveness	Platform Upgrades_Land	1106	01	0702808M	1448	260	1816
USMC	Medium Tactical Vehicle Replacement (MTVR)	Fuel Efficient MTVR FNC Transition	Through analysis, modeling and simulation, hardware development, integration, test, and evaluation, the Fuel Efficient Medium Tactical Vehicle Replacement (MTVR) FNC program will select, bench test, and integrate a suite of affordable fuel efficiency enablers.	Increase Warfighter Capability	Platform Upgrades_Land	1319	07	0206624M	740	1057	1389
USMC	Medium Tactical Vehicle Replacement (MTVR)	Fuel Efficient MTVR FNC Transition	Through analysis, modeling and simulation, hardware development, integration, test, and evaluation, the Fuel Efficient Medium Tactical Vehicle Replacement (MTVR) FNC program will select, bench test, and integrate a suite of affordable fuel efficiency enablers.	Enhance Mission Effectiveness	Platform Upgrades_Land	1109	05	0206315M	3808	5137	33121

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
USMC	Mobile Power Equipment	Advance Mobile Medium Power Sources	The Family of Mobile Power Equipment is a family-of-systems to continuously procure, update, and replenish approximately 19,000 items of Mobile Tactical Power Generation & Distribution Equipment to include the AMMPS system, and 22 different TAMCNs. The Family of Mobile Electric Power Equipment consists of skid & trailer mounted tactical generators ranging from 2 to 200 kilowatts, Mobile Electric Power Distribution Systems, Floodlight Sets, Load Banks & Electrician's Tool Kits. This equipment is procured & fielded to provide electricity on the battlefield. Combat, combat support & combat service support units all require tactical power to operate weapons systems, C4I systems, medical & messing facilities, environmental control equipment, & water purification systems.	Enhance Mission Effectiveness	Contingency Basing	1109	06	0206315M	3493	6674	34984
USMC	Mobile Power Equipment	Advance Mobile Medium Power Sources	The Family of Mobile Power Equipment is a family-of-systems to continuously procure, update, and replenish approximately 19,000 items of Mobile Tactical Power Generation & Distribution Equipment to include the AMMPS system, and 22 different TAMCNs. The Family of Mobile Electric Power Equipment consists of skid & trailer mounted tactical generators ranging from 2 to 200 kilowatts, Mobile Electric Power Distribution Systems, Floodlight Sets, Load Banks & Electrician's Tool Kits. This equipment is procured & fielded to provide electricity on the battlefield. Combat, combat support & combat service support units all require tactical power to operate weapons systems, C4I systems, medical & messing facilities, environmental control equipment, & water purification systems.	Enhance Mission Effectiveness	Contingency Basing	1106	01	0206624M	100	102	501

Table 11. Navy FY 2018 Operational Energy Initiatives (Dollars in Thousands)

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	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	01	0408042N	576	715	2024
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	01	0408042N	163	145	737
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	01	0408042N	200	150	550
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	01	0408042N	816	726	3123

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	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	01	0408042N	652	810	4257
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	01	0408042N	1181	1075	5966
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.	Increase Warfighter Capability	Platform Upgrades_Sea	4557	01	0408042N	1631	1308	11913
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	01	0408042N	1631	1986	11049
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	01	0408042N	6000	4814	9153

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	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 usage.	Enhance Mission Effectiveness	Metering and Monitoring	4557	02	0408042N	1875	779	1119
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	1492	1213	3815
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	1680	1155	4368
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	700	125	3313
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	3300	1625	13751
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.	Increase Warfighter Capability	Platform Upgrades_Sea	4557	02	0408042N	0	0	13592

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	220	2780
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	2100	1890	2390
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	Contingency Basing	4557	05	0408042N	1400	890	6870
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	0	2198	11096
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	5100	610	610
NAVY	Aircraft Energy Conservation	F-35 'Smart Start' Energy Conservation Mode	This initiative will optimize the fuel efficiency of the F-35 air vehicle with attention to the PTMS Pre-Flight Operational Mode, GPS Approach Capability, CTOL /CV Nozzle Optimization, and Subsystem Standby Modes. These technologies will be forward fit in F-35 Block 5 (2020) and beyond.	Increase Warfighter Capability	Platform Upgrades_Air	1319	04	0603724N		350	450
NAVY	Aircraft Energy Conservation	F-35 Trim-Optimizing Flight Control	Leverage F/A-18 Trim-Optimizing Flight Control investments to achieve a 1.8% reduction in surface control drag (15 nm mission radius improvement).	Increase Warfighter Capability	Platform Upgrades_Air	1319	04	0603724N		1150	3950
NAVY	Aircraft Energy Conservation	New 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	2900	9500	51151
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	Training and Education	1319	04	0603724N	700	1400	6700
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	889	1100	1550

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
NAVY	Aircraft Energy Conservation	F414 Enhanced Engine	Optimize the fuel efficiency of the F414 engine 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		9700	60100
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	3700	1200	2050
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	Alternative Fuels	1319	04	0603724N	8100	12801	63002
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	630	1439
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	0	159	4735
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	4387	6178	20940
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	0	139	2262
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	1264	6666

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	650	3184
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	0	0	12894
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	115	800	860
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	0	260	5404
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	3501	2780	2780
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	718	814	4094
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	Reduce Logistics Risks to Mission	Alternative Fuels	1319	02	0602236N	1339	1363	6842
NAVY	Future Naval Capabilities Applied Research	Combat Power and Energy Control System	Combat Power & 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	0	0	7354
NAVY	Future Naval Capabilities Advanced Tech Dev	Combat Power and Energy Control System	Combat Power & 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	0	0	17446
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	1212	953	953

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	582	505	505
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	2166	2455	12360
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	10738	10541	54795
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	14865	14592	75855
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	2226	2524	12703
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	0	5223	14654
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	0	4927	14645

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	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 systems.	Increase Warfighter Capability	Platform Thermal Management	1319	01	0601153N	1624	1841	9270
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	1650	1841	1841
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	3050	4200	4200
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	0602792N	0	8000	17000
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	2074	1874	3077
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	2858	2402	4904
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	Alternative Fuels	1319	01	0601153N	840	893	4308

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	903	889	4654
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 Fuels	1319	01	0601153N	1047	1419	7252
NAVY	POWER PROJECTION 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	0602114N	375	1215	2780
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	Individual/Warfighter Power	1319	02	0602123N	1694	1734	8807
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 Fuels	1319	02	0602236N	552	566	2871

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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 Fuels	1319	02	0602435N	0	968	968
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	550	2701
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	7743	8776	44184
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	8491	8477	43500
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	3533	3527	18116

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
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	1624	1813	9295
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	1988	1874	2960
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	4630	4202	9999
NAVY	DEFENSE RESEARCH SCIENCES	Synthetic Biology for Sensing & Energy Production	Develop transformational approaches using living organisms to produce, fuels or other high-value compounds	Reduce Logistics Risks to Mission	Alternative Fuels	1319	01	0601153N	446	500	2510
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	5580	6818	16122
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	6020	5482	21233

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	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	1200	1200	6000
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.	Increase Warfighter Capability	Platform Upgrades_Sea	1804	01	0204411N	3028	4520	15172
NAVY	Items Less than \$5Mil	Environmental Control Unit 50 (ECU50/NETTP)	Develop and field ECU technology to: -Decrease fuel required for ECUs by 20% (threshold) to 50% (objective) -Equipment rated for expeditionary operating environments -Fit within the size/weight envelope of current deployed systems -No increase in required logistics support -Procurement cost that is <25% higher than current deployed systems	Reduce Logistics Risks to Mission	Contingency Basing	1810	05	0204455N	0	2350	10090
NAVY	Advance Surface Machinery Sys	Energy Storage	ESO assumes responsibility 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	Power Controls and Distribution	1319	04	0603573N	2500	1000	1000

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	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, Twin Spool, 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. Twin Spool 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	Platform Upgrades_Sea	1319	04	0603573N	5296	2972	13350
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.	Increase Warfighter Capability	Platform Upgrades_Sea	1810	01	0204228N	3119	5087	12835
NAVY	Maritime Energy Initiatives (MEI)	DDG 51 Hangar Bay Solid State Lighting (HBSSL)	Full fixture replacement in Hangar Bays with LED fixture. Reduces amount of fixtures in half for each hangar bay, reducing weight, electrical load, and maintenance actions.	Increase Warfighter Capability	Platform Upgrades_Sea	1810	01	0204228N	0	456	2911
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.	Increase Warfighter Capability	Platform Upgrades_Sea	1810	01	0204228N	9136	8222	44982
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 simplifies maintenance.	Increase Warfighter Capability	Platform Upgrades_Sea	1810	01	0204228N	3613	4344	30377
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.	Increase Warfighter Capability	Platform Upgrades_Sea	1810	01	0204228N	0	1544	15456

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	FYDP
NAVY	Maritime Energy Initiatives (MEI)	DDG 51 FLT IIA Shipboard Energy Dashboard (SED FLT IIA)	Shiboard tool providing real-time situational awareness of the energy demand associated with equipment line-ups and mission for DDG FLT IIA platforms.	Increase Warfighter Capability	Metering and Monitoring	1810	01	0204228N	298	217	217
NAVY	Maritime Energy Initiatives (MEI)	DDG 51 FLT I Shipboard Energy Dashboard (SED FLT I)	Shiboard tool providing real-time situational awareness of the energy demand associated with equipment line-ups and mission for DDG FLT I platforms.	Increase Warfighter Capability	Metering and Monitoring	1810	01	0204228N	0	0	3013
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 as needed.	Increase Warfighter Capability	Metering and Monitoring	1810	01	0204228N	0	0	3364
NAVY	Common Group Equipment	Simulator Upgrades	The Navy Aviation Simulator Master Plan (NASMP) identified capability (fidelity) and capacity upgrades required to maximize T&R simulation for F/A-18E/F, EA-18G, and MH-60R/S aircraft given fiscal, technological, and minimum flight time limitations.	Increase Warfighter Capability	Current Operations Tools	1506	07	0804743N	68855	74066	222540
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.	Increase Warfighter Capability	Platform Upgrades_Sea	1810	01	0204411N	1912	1990	25545
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	15132	6331	12198

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objective	OE Activity Classification	Treas Code	BACode	Program Element	FY 2017	FY 2018	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	1319	05	0604567N	0	986	1770
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	Platform Upgrades_Sea	1810	01	0204228N	662	748	3885

Table 12. Defense-Wide FY 2018 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 2017	FY 2018	FYDP
DLA	Innovative Products and Services for DLA Customers	Energy Efficiency & Alternative Energy Technologies	Energy Readiness Program (ERP) addresses current and future issues connected to areas encompassing the Class III Bulk (Petroleum, Oils and Lubrication) fuel supply system in order to maintain and improve current warfighter product requirements.	Reduce Logistics Risks to Mission	Energy Readiness	0400	03	0603712S	1,000	2,229	11,004
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	391	0	0
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	03	0603380S	1,678	1,792	19,334
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
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