

Fiscal Year 2021 Operational Energy Budget Certification Report



**Assistant Secretary of Defense for
Sustainment**

July 2020

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Executive Summary

The Fiscal Year 2021 Operational Energy Budget Certification Report satisfies the reporting requirement in section 2926(c) of title 10, United States Code, and the report request in House Report 112-479, page 121, accompanying H.R. 4310, the National Defense Authorization Act for FY 2013. This report highlights the alignment of Department-wide and Component-specific operational energy initiatives, per the *2016 Operational Energy Strategy*, with the President's Budget.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.

The Fiscal Year (FY) 2021 President's Budget continues to support the objectives of the 2018 *National Defense Strategy* (NDS) as the Department of Defense (DoD) increases demand for the assured delivery and effective use of energy in military operations to defend the homeland, sustain Joint Force military advantages, and deter aggression.² The *Operational Energy Strategy* reinforces the role of assured delivery of energy to the warfighter in enabling worldwide missions, and establishes objectives for increasing future capabilities and reducing risks associated with dependence on vulnerable supply lines.

The proposed budgets of each Component were compared against the three objectives in the *Operational Energy Strategy*: 1) Increase future warfighting capability; 2) Identify and reduce logistics and operational risks; and 3) Enhance mission effectiveness of the current force. This comparison serves as the basis for the Green/Yellow/Red assessments provided within this report. Component support of the *Operational Energy Strategy* objectives were rated green as adequately funded, amber as marginally funded, or red as inadequately funded. It is important to note that green ratings indicate objectives are funded to a level that allows adequate progress throughout the fiscal year, not that the objective is complete.

The Department requested more than \$3.2 billion for the execution of operational energy initiatives in FY 2021. These investments procure new or upgrade existing equipment, improve propulsion, adapt plans, concepts, and wargames to account for increasing risks to logistics and sustainment, and enhance the role of energy considerations in developing new capabilities. The report highlights investments in key initiatives, while **Table 1** shows the overall funding of the Department's operational energy program.

¹ *2016 Operational Energy Strategy*. This strategy is accessible via: http://www.acq.osd.mil/eie/Downloads/OE/2016percent20Oepercent20Strategy_WEBd.pdf

² *Summary of the 2018 National Defense Strategy*. Pg. 3. This strategy is accessible via: <https://www.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>

Table 1. DoD Operational Energy Investments by Strategy Objective, FY 2021 (\$ Millions)

Operational Energy Strategy Objectives	OSD	Air Force	Army	Navy	Marine Corps	Total
Enhance Mission Effectiveness of the Current Force		\$1	\$1,173	\$21	\$32	\$1,227
Increase Future Warfighting Capability		\$892	\$681	\$130	\$16	\$1,719
Identify and Reduce Logistics and Operational Risks	\$12	\$7	\$62	\$240		\$321
<i>Total</i>	\$12	\$901	\$1,916	\$391	\$48	\$3,267

Separate from these investments and overseen by the Office of the Under Secretary of Defense (Comptroller), the FY 2021 budget also includes the Defense Logistics Agency (DLA) estimate of fuel (Appendix D provided as a reimbursable good to the Military Departments.

In accordance with title 10, United States Code, section 2926(c), the Assistant Secretary of Defense for Sustainment (ASD(S)) certifies that the FY 2021 President’s Budget for the Department is adequate for implementing the objectives of the *Operational Energy Strategy*.

Office of the Secretary of Defense

As the senior energy advisor to the Under Secretary of Defense for Acquisition & Sustainment (USD(A&S)), the ASD(S) oversees and supports operational energy programs across the Department. Office of the Secretary of Defense (OSD) support to operational energy occurs through day-to-day operations of the Office of the Deputy Assistant Secretary of Defense for Energy (ODASD(Energy)), the Defense Logistics Agency (DLA)-Energy, and the USD (Research & Engineering (R&E))-led Operational Energy Capability Improvement Fund (OECIF).

OASD(S)

In 2018, the ODASD for Installation Energy merged with ODASD for Operational Energy to establish the ODASD(Energy). Combining efforts around resilience and assured energy for our forces reflects the *National Defense Strategy*'s assertion that the "homeland is no longer a sanctuary" and addresses department-wide business reforms. ODASD(Energy) uses Operation & Maintenance resources (**FY 2021, \$6.0M**) to oversee and integrate Department energy initiatives, to include implementation of the *Operational Energy Strategy*.

In FY 2021, ODASD(Energy) will continue its role in developing policy and conducting oversight regarding the Department's use of operational energy. ODASD(Energy) will be updating operational energy policy and governance, including Department of Defense Directive 4180.01, *Defense Energy Policy*, and Department of Defense Instruction 4140.25, *DoD Management Policy for Energy Commodities and Related Services*, with a focus on including energy resilience and cybersecurity. Building on the first Joint Force Energy Wargame held in FY 2019, ODASD(Energy) is planning a second wargame for FY 2021 that would evaluate energy infrastructure deficiencies and energy planning gaps. In addition, ODASD(Energy) will continue to work with the Combatant Commands, the Services, the DLA-Energy, and other energy stakeholders to identify operational energy policy requirements.

ODASD(Energy) Rating: GREEN ODASD(Energy) efforts in FY 2021 are aligned with the goals of the NDS, and will create policy, share information, and solve challenges related to operational energy use across the Department. Additional information on ODASD(Energy) initiatives and responsibilities can be found in Appendices A, B, C, and E.

Defense Logistics 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. DLA's contributions to the Department's

operational energy objectives are found in the development and implementation of advanced batteries, and petroleum-based and alternative (non-petroleum) fuels. DLA proposed \$6.1M in FY 2021 to Identify and Reduce Logistics and Operational Risks of the Current Force.

Battery Network (BATTNET) (FY 2021, \$3.9M), is a manufacturing technology program designed to reduce production and product costs while improving battery availability, performance, and standardization. BATTNET links battery supply chain members, engineering support activities, researchers, and users to address sustainment issues or risks and bridge technical solutions. BATTNET's goal is to improve DoD battery logistics through the development and/or use of lighter weight, higher performance, longer shelf life, and lower maintenance batteries. Future BATTNET initiatives include production design improvements to the new conformal soldier battery that has 55 percent more energy density and costs 20 percent less than current batteries. BATTNET initiatives also support transitioning military supplies from outdated versions of lead-acid (flooded/wet) or nickel-cadmium to more advanced lead-acid technologies (AGM) or Li-ion storage solutions. BATTNET is also transitioning Small Business Innovative Research initiatives in manufacturing, logistics, and materials reclamation. BATTNET enhances mission effectiveness of the current force.

The **Energy Readiness Program (FY 2021, \$2.2M)** 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. These areas include improvements to military acquisition specifications; development of new analytical methods; development of renewable fuels and energy technologies; and improvements to DoD fuel storage, handling and distribution systems. Together, this initiative reduces logistics and operational risks associated with the Class III Bulk supply system.

Defense Agency Assessment Rating: GREEN. Progress was made on the energy storage standardization process, but additional efforts are needed to more closely align requirements with existing inventory to reduce overall battery variety across the Department. The OASD(S) assessed the proposed FY 2021 budget for OSD and DLA as adequate for the implementation of the *Operational Energy Strategy*.

OUSD(R&E)

As part of the November 2018 re-organization of the former Under Secretary of Defense for Acquisition, Technology, and Logistics, management of the Operational Energy Capability Improvement Fund (OECIF) moved to the Office of the Deputy Director for Research, Technology, and Laboratories within OUSD(R&E).

OECIF (FY 2021, \$0.0M) was an advanced technology development program that matured operational energy technologies from Technology Readiness Level (TRL) 3,

characterized by analytical and laboratory studies, to TRL 6, characterized by a model or prototype system tested in a relevant environment. Over 37 percent of DoD-wide advanced technology demonstration (6.3) funding in FY 2020 for operational energy technology maturation was executed out of the OECIF program.

During the the Defense Wide Review in winter 2019-2020, a decision was made to terminate the OECIF program in FY 2021. Funds from OECIF were moved to other priorities within the USD(R&E) portfolio in accordance with the Defense Wide Review. Funding provided to OECIF in FY 2020 will be dedicated to closing out ongoing OECIF projects and meeting the energy storage and microgrid requirements identified in Section 239 of the FY 2020 National Defense Authorization Act.

OECIF Rating: YELLOW. As a part of the Defense Wide Review in winter 2019-2020, OUSD(R&E) looked at Service activities in operational energy, weighed the investment against broader DoD priorities, and decided to cease funding for this program. However, given the role of OECIF in supporting Joint technology demonstration activities for operational energy, OUSD(R&E) is working with the Services to ensure ongoing research activities transfer to Service oversight and that Joint capabilities gaps and opportunities remain a priority. In addition, OUSD(R&E) and OUSD(A&S) will collaborate to identify Joint operational energy research and development requirements, and review the alignment of Department resources with these requirements.

Air & Space Forces

For FY 2021 the Air Force and Space Force budgeted a combined \$901M for investments that have an operational energy benefit, including \$893M to Increase Future Warfighting Capability, \$7M to Identify and Reduce Logistics and Operational Risk, and \$0.5M to Enhance Mission Effectiveness of the Current Force.

As the Department's largest operational energy consumer, the Air & Space Forces leverage technology, data, and innovative thinking, to enable its warfighters to expand operational effectiveness by fueling more fight. While the Air Force has no dedicated operational energy investments for FY 2021, Air Force investments provide significant improvements in range, endurance, and operational energy impact and are included in Appendix E. Many of these investments were done out of necessity for aging equipment, to increase capabilities like range, payload, or time-on-station, or to allow for new high-energy weapons systems on platforms. While operational energy use is not expected to decrease because of these investments, the Air Force will gain significant capability for the same amount of energy used.

The most significant investments support Increased Warfighter Capability and Enhanced Current Mission Effectiveness.

The **Adaptive Engine Transition Program (AETP) (FY 2021, \$636.5M)** is developing and fabricating prototype jet engines with a modulated third air stream, allowing the thrust responsiveness required for a fighter when needed, and the efficiency of a higher bypass ratio engine during cruise. This novel engine technology is applicable to multiple combat aircraft applications. AETP technology translates into significant increases in range and loiter, a reduction in required tanker sorties, and significant increases in thermal management capability to extend low-altitude loiter time.

Megawatt Aircraft Power & Thermal (FY 2021, \$21.7M) is a technology development effort for aircraft power and thermal components combined with advanced architectures to enable high-power-demand mission systems. Megawatt (MW) Aircraft aims to enable 1 MW airborne power generation, yielding approximately 250 kilowatts (kW) for directed energy capability with acceptable system impact. MW Aircraft, combined with AETP and other pending adaptive engine technologies, have the potential to yield highly effective self-defense and offensive weapons capabilities for combat aircraft.

Additional information on Air Force energy initiatives can be found in Appendix E.

Air & Space Forces Rating: YELLOW. While significant, the Air Force notes that many investments are being pursued for reasons other than increases in operational reach or decreases in energy risk. Instead, these investments are driven by aging equipment, capability improvements, and mission requirements. OASD(S) recognizes the significance of these Air Force investments, particularly in propulsion, but is concerned over the lack of resources focused on the near-term optimization of energy use in operations. Currently, these focused energy investments are run out of year-to-year Congressional add funding, leading to competition for investments and uncertain program stability. The Air Force would benefit from a dedicated funding stream for near-term, quick-return on investment energy initiatives, as well as a dedicated program line for the Air Force energy office to facilitate longer-term energy projects. OASD(S) looks forward to working with the Air Force to address this concern.

Army

The Army budget request for Fiscal Year 2021 supports the Army's efforts to restore readiness by 2022 and field a multi-domain capable force by 2028 to achieve the objectives of the Army Vision and support the National Defense Strategy by building readiness for high-intensity conflict; modernizing doctrine, equipment, and formations; and reforming Army business practices to maximize time, money, and manpower. For FY2021, the Army budgeted \$1,908M for energy-related investments. In support of efforts to rebuild readiness, \$1,326M will enhance the mission effectiveness of the current force, which includes \$62M for capabilities that reduce logistics and operational risks. In addition, the Army budgeted \$582M to increase future warfighting capabilities through modernization.

The Army recognizes energy enables readiness and is critical to the ability to conduct and support operations. Energy enables maneuver, increases mobility, and creates greater freedom of action by extending operational reach and endurance. The Army's energy-related investments are advancing warfighter capabilities, ensuring our current and future vehicles and weapons systems have the automotive power, electrical power and lethality necessary to complete their missions, while Soldiers have the power necessary to achieve dominance using advanced Soldier-borne capabilities across a multi-domain capable force. Readiness investments are overcoming the challenges posed by the weight of increased armor and the power requirements of modern sensor, protection, and mission command systems, while also preparing the systems to integrate emerging future capabilities. Some examples of readiness investments include:

- The M1A2C Abrams Main Battle Tank upgrade (**FY 2021, \$11.4M**) increases the electrical capabilities to ensure the tank has the electrical capability to support all current and planned capabilities, while the Auxiliary Power Unit provides power at the halt that is expected to reduce fuel consumption by eight percent over a combat day. In addition, the Advanced Reliability and Cost Savings improvement program for the main engine will reduce fuel consumption by over 14 percent.
- M2A4 Bradley Infantry Fighting Vehicle upgrade (**FY 2021, \$107.8M**) improves the automotive and electrical power of the vehicle, restoring mobility lost to weight increases while providing sufficient electrical power for current and future capabilities.
- M109A7 Paladin 155mm Self-Propelled Howitzer upgrade (**FY 2021, \$435.8M**) brings a tried and tested vehicle up to modern standards. The new hull and powertrain have mobility and protection capabilities similar to the Bradley, while the 70kW of electrical power replaces the hydraulic systems with electric motors, improving accuracy and reliability.

To deliver a multi-domain capable force by 2028, the Army is investing in modernization in alignment with the Army Modernization Strategy published in October 2019. The strategy describes how the Army will modernize how they fight, what they fight with, and who they are. This approach integrates the elements of doctrine, organizations, training, materiel, leader development and education, personnel, facilities, and policy (DOTMLPF-P) within the Army, with other Joint Force elements, and alongside allies and partners. The Army's reform efforts have aligned the Army Modernization Enterprise under a single command with the formation of Army Futures Command, and realigned billions of dollars of funding to focus on the top modernization priorities to create and deliver a multi-domain capable force within the next eight years.

Investments in modernization are focused on the six Army modernization priorities: long range precision fires, next generation combat vehicles, future vertical lift aircraft, network technologies, air and missile defense capabilities, and Soldier lethality. The energy-related investments in support of this portfolio of capabilities are primarily directed at advancing the science and technology necessary to power multi-domain capabilities as they become available. Some examples of the technologies under development include:

- Advanced powertrains that allow manned and unmanned aircraft to fly faster, higher, with greater payloads for longer ranges. These technologies will reduce fuel burn and maintenance requirements while providing more capability and increasing reliability.
- Modular electrification architectures with common subsystems that can increase vehicle mobility, decrease weight, improve acceleration, improve fuel economy, and increase power availability and management for mission systems. In addition, these technologies have the potential to extend duration and enable silent mobility and silent watch.
- Mobile, scalable, and modular tactical power standards, components, and controls for battlefield power generation, distribution, and storage. When implemented, these technologies can reduce fuel, increase resiliency, and make energy systems more flexible.
- Advanced power and energy technologies for the dismounted Soldier. These technologies will reduce the Soldier-borne weight burden and increase power duration through improved architectures, improved energy density storage, and multi-option lightweight recharging options that keep pace with emerging powered equipment development.

The Army Strategy is the guidebook to how the Army supports the National Defense Strategy by regaining and maintaining readiness, modernizing the force for multi-domain operations, and reforming the way the Army conducts business to develop a constantly

modernizing Army that is, and remains, the dominant land force on Earth. The Army's investments in energy-related capabilities enable that dominance now and into the future.

Additional information on Army energy initiatives can be found in Appendix E.

Army Rating: **GREEN**. The OASD(S) assesses the Army's proposed FY 2021 budget as adequate for the implementation of the *Operational Energy Strategy*.

Department of the Navy

Focused on meeting the demands of the National Defense Strategy, the Department of the Navy (DON) continues to enhance the lethality and effectiveness of forces through increased energy resilience, operational reach, and time-on-station of forward deployed naval forces. Department-wide efforts in research and development are focused heavily on solving operational energy challenges related to the deployment of directed energy weapons and advanced sensors, unmanned and manned capabilities on ships requiring advanced batteries, and distribution of fuel in contested operating environments. With an emphasis on solving challenges associated with the deployment and employment of advanced batteries across all platforms and forces, the DON has instituted policy to establish an advanced battery coordination office within the Naval Seas Systems Command.

Navy

In FY 2021 the Navy budgeted **\$391M** for operational energy investments, including **\$130M** to Increase Future Warfighting Capability, **\$240M** to Identify and Reduce Logistics and Operational Risk, and **\$21M** to Enhance Mission Effectiveness of the Current Force.

Aligned to the NDS, the Navy's warfighting strategies employ a distributed operating concept that increases the significance of forward logistics capability. The Navy's largest FY 2021 investment continues development of the MQ-25A, a CVN-based unmanned aerial tanker, which is largely responsible for the increase in OE funding for the Navy. The **MQ-25A (FY 2021, \$214M)** will extend the range and increase lethality of the carrier strike group's air wing, and will alleviate the F/A-18 E/F shortfall by relieving tanker duties and returning the aircraft to the strike fighter role. Further, the Navy is investing in afloat fuel infrastructure to replace the Off Shore Petroleum Distribution System and create a more reliable, and robust fuel distribution network. This includes the **Sea based Petroleum Distribution System (FY 2021, \$13M)** and **Improved Modular Fuel Delivery System (FY 2021, \$4M)**.

Navy's future warfighting strategies will employ directed energy weapons and high energy sensors that would stress conventional power generation architectures. Recognizing the

importance of energy storage and electrification of ships and aircraft, the Navy is continuing investment in the **Electric Ships** program (FY 2021, \$32M), to include **Energy Magazine** development. Additionally, **Power Science and Technology** investments (FY 2021, \$8M) at the Office of Naval Research, and the Electric Ship Research and Development Consortium (FY 2021, \$11M) will transition research to enable advanced architectures for future warfare systems.

Battery Research (FY 2021, \$48M) is critical to electrification and enables nearly every warfighting asset. Without compromising safety, the Navy will continue to push for maximum range out of our unmanned systems, and pursue smaller, lighter energy storage. In FY19, the DON established coordinated battery development and safety to ensure safe, deployable, and affordable energy storage is available to current and future systems.

The Navy continues investments to optimize energy demand. **Propulsion Task Force Energy (FY 2021, \$8.7M)** is developing variable geometry and adaptive cycle gas turbine engine technology for next generation air dominance aircraft in partnership with the Variable Cycle Advanced Technology (VCAT) program. The benefits of these technologies include significantly improved engine durability and performance and result in reduced maintenance, reduced fuel consumption, and improved operational range. The reduction in fuel demand will reduce the logistics tail for deployed fuel and tanker aircraft support. Projects in afloat power and energy programs, including Hybrid Electric Drive, Biofouling research, and generation efficiency research will realize greater operational reach and time on station, and reduce demand on logistics.

The Navy will continue investment in the **Mobility Fuels program (FY 2021, \$7M)** to provide testing and certification capabilities to ensure the Navy has access to reliable sources of fuel worldwide and maintain the ability to assess fuel quality deficiencies as they arise.

The Navy will continue to pursue technologies and methods to enable data-driven decisions. The **Global Energy Information System (GENISYS) (FY 2021, \$4.7M)** integrates shipboard metering, and provides a dashboard for displaying critical power and energy information. Appropriately applied, this data enables optimization of the ships plant configuration and speed for maximum capability. The Navy will integrate additional tools, such as Non-Intrusive Load Monitoring, Maritime Tactical Command and Control, and Enterprise Remote Monitoring, to further optimize shipboard equipment and establish power grid cyber security.

Navy Rating: GREEN. Due to an increase in investment and focus on power, advanced batteries, and fuel distribution, OASD(S) assesses the Navy's proposed FY 2021 budget as adequate for the implementation of the *Operational Energy Strategy*.

Marine Corps

In FY 2021 the Marine Corps budgeted **\$4.8M** for operational energy investments, including **\$16.3M** to Increase Future Warfighting Capability, and **\$31.7M** to Enhance Mission Effectiveness of the Current Force. The Marine Corps is adjusting its OE investment profile to meet the Commandant's Planning Guidance, modernize legacy platforms, and invest in new technologies to enable the sustainment of distributed forces executing Expeditionary Advanced Base Operations (EABO). As such, the Marine Corps budgeted well over 70 percent of OE investments to the Enhance Current Mission Effectiveness objective.

The **Advance Power Sources Program (FY 2021, \$19.1M)** is a family of small power devices that provide portable alternative electric power for legacy and future weapons, optics, sensors, medical, intelligence, and communications systems in expeditionary environments. 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. These initiatives include power production, distribution, storage, and management capabilities that will drive increased self-sufficiency, operational reach, and readiness. These initiatives will eliminate or reduce need for fuel resupply, reduce weight, and enable silent operations.

The **Fuel Efficient Medium Tactical Vehicle Replacement (FE MTRV) (FY 2021, \$7.1M)** addresses the 'workhorse vehicle' of the MAGTF. The Marine Corps intends to further integrate, test, and evaluate a range of previously developed improvements in order to verify the most effective suite of affordable fuel efficiency enablers to install on the vehicle. While the fielding plan for the platform is still under development, the USMC estimates include 6,100 FE MTRVs within the FYDP.

Mobile Electric Power Equipment (FY 2021, \$7.7M) 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 Advanced Medium Mobile Power Sources (AMMPS). This family of generators includes skid & trailer mounted tactical generators ranging from 1 to 60 kilowatts, Mobile Electric Power Distribution Systems, Floodlight Sets, Load Banks & Electrician's Tool Kits. AMMPS will reduce logistical footprint and reduce fuel consumption by an average of 21 percent over the aging Tactical Quiet Generator (TQG) fleet, and other system improvements and investments will reduce fuel usage further. An associated benefit includes the ability to right size generators to power, thus increasing fuel efficiency.

The **Expeditionary Energy Office (E2O) (FY2021, \$5.0M)** is maintaining its strategic role in defining the future needs and investments required to mitigate emerging capability gaps. This begins with coordination with the Navy to define Joint bulk fuel distribution requirements for validation by the Joint Staff. E2O also developed, demonstrated, and transitioned two expeditionary bulk fuel capabilities that can quickly set up and take down Forward Arming and Refueling Points (FARPs) in austere locations. The capabilities are designed to be aviation insertable via MV-22 and able to operate without significant support. The Mobile Amphibious Assault Fuel Distribution (MAAFD) effort will result in concept development experimentation that will analyze the effectiveness of current and modified capabilities in meeting the decentralized amphibious fuel distribution network required to support future operating concepts. This effort is closely coordinated with the Navy and other joint partners. In addition, MAAFD demonstrated the Tactical Aviation Ground Refueling System (TAGRS) that provides the equipment to tap into a fuel source and create a two-spot fueling point for aircraft. The Expeditionary Mobile Fuel Additization Capability (EMFAC) provides the capability to additize commercial fuel to meet DoD specifications and is being deployed to meet the requirements of an Urgent Universal Needs Statement submitted by the operating forces. These capabilities were successfully demonstrated and funding was identified to transition the efforts to programs of record.

Marine Corps Rating: GREEN. The OASD(S) assesses the Marine Corps' proposed FY 2021 budget as adequate for the implementation of the *Operational Energy Strategy*.

Conclusion

The ASD(S) certifies that the FY 2021 President's Budget for the Department of Defense (DoD) is adequate for implementing the objectives of the *Operational Energy Strategy*. The current objectives of improving long-term capability, identifying and decreasing operational risk, and enhancing mission effectiveness of the current force align with and enhance the goals of the *National Defense Strategy*.

Looking ahead, the Department will establish a comprehensive energy strategy that aligns to *National Defense Strategy* priorities by focusing on energy resilience for both forces and facilities. The unified Department energy strategy will provide the basis for meeting the budget certification requirement in section 2926(c) of title 10, United States Code. Given the need for resilient and agile logistics, the Department will continue to invest in energy initiatives that increase joint capability at best cost and provide combat capable forces and facilities to deter war and protect our nation's security.

Appendix A. Operational Energy in Requirements and Planning

In accordance with the Carl Levin and Howard P. Buck McKeon National Defense Authorization Act for Fiscal Year 2015, section 2926, this appendix to the FY 2021 DoD Budget Certification report describes actions taken by the Joint Requirements Oversight Council (JROC) to complete implementation of the Energy Key Performance Parameter (eKPP) and details how operational energy is being addressed in defense planning scenarios, support to strategic analysis, and policy to improve combat capability. This Chairman’s Appendix describes the Joint Staff actions completed in FY 2019.

The Joint Requirements Oversight Council completed implementation of the energy Key Performance Parameter for all programs in 2017, and streamlined the Joint Capabilities Integration and Development System (JCIDS) process in 2018.

The JROC, chaired by the Vice Chairman of the Joint Chiefs of Staff, implemented DoD Operational Energy policy through the JCIDS process. The military Service sponsors define eKPPs as needed using energy supportability analysis to balance the energy performance of warfighting systems with the provisioning of energy inside threat environments. The context of an entire unit of maneuver, energy sources of supply, the most-stressing scenario, future force structure, and adversary actions shape the analysis. The JROC delegated oversight for the eKPP to the military Service sponsors, however, it reserved authority to oversee eKPP for large programs that may significantly impact the operational energy burden of joint forces. For this reason the Joint Staff reviewed energy performance parameters during FY 2019 for the Ground Based Strategic Deterrent; DDG 1000 Guided Missile Destroyer; and Guided Missile Frigate FFG(X) programs and in each case concurred on the Service sponsor’s performance parameters.

The JROC implemented an eKPP waiver procedure because most new capabilities do not create significant impact on the operational energy supply chain for the joint force. This relieved the military Service sponsors from the requirement to complete energy supportability analyses and establish eKPPs for new capabilities that will not be net energy intensive. Waiver eligible programs include software-only capabilities; contiguous United States-only, non-deployable, or training capabilities; capabilities with self-contained or nuclear energy sources that are not “energy providers” such as expendable munitions and satellites; and permanent component replacement in accordance with system engineering plans for existing platforms. This defined waiver procedure streamlined the JCIDS process, reduced non-value added work, and enabled better oversight of critical capability requirements that will significantly affect energy demand.

Operational energy is being addressed in defense planning, scenarios, support to strategic analysis, and policy to improve combat capability.

Operational Energy principles are integrated into relevant defense planning scenarios, support to strategic analysis, and resulting policy during routine revisions. The *Operational Energy Strategy* directs the management of energy related risks in deliberate planning. Combatant Commander Campaign and Posture Plans now incorporate Operational Energy and Energy Security considerations which affect access, agreements, logistics sufficiency, and integrated priorities. Logistics assessments for fuel or energy sufficiency are completed for all Operational Plans and Contingency Plans, and the fuel and energy assessments are reflected in the Chairman's Risk Assessment and in the more detailed Joint Logistics Estimate and Global Logistic Readiness Dashboard. Operational Energy is now factored into modeling, wargames, and large exercises. Examples of recent FY 2019 Joint Tier 1 exercises include the following: Judicious Response, Epic Guardian, Internal Look, Invincible Sentry, Cyber Flag, Cyber Lightning, Austere Challenge, Juniper Falcon, Ardent Shield, Vigilant Shield, Pacific Sentry, Tempest Wind, Fused Response, Integrated Advance, Global Lightning, Global Thunder, Turbo Challenge, and Ultimate Guardian. Strategic analysis for fuel and energy sustainability was accomplished using these exercises, wargames, and associated modeling tools such as the Air Force "4G" Wargaming Tool; USMC Marine Air-Ground Task Force Power and Energy Model (MPEM); Army Operational Energy Analysis Task Force (OEATF); and the Synthetic Theater Operations Research Model (STORM) campaign model.

Prepared By: The Joint Staff Director for Logistics (JS J4)

Approved By: The Chairman of the Joint Chiefs of Staff (CJCS)

Appendix B. Operational Energy in the Procurement Process

Pursuant to title 10, United States Code, section 2926, this appendix to the FY 2021 Operational Energy Budget Certification Report certifies and describes how the acquisition system is addressing operational energy in the procurement process, including long-term sustainment considerations, and how programs are extending combat capability as a result of these considerations.

The Department addresses operational energy throughout its procurement process with particular attention given to planning and concept development in an effort to shape preliminary weapons system design. The Assistant Secretary of Defense for Sustainment (ASD(S)) ensures that operational energy is addressed throughout the acquisition process by certifying that operational energy is addressed in acquisition documentation where applicable. In addition, Services consider operational energy in their title 10 wargames and in other wargames where applicable. The results of the energy supportability analysis (ESA) should determine the value of the energy key performance parameter, a system requirement. Finally, the Department looks to the science and technology community for advancements in energy storage, energy consumption, and other areas that impact energy usage, such as lighter weight materials.

As part of its planning efforts, the Department ensures that operational energy plays a role in wargames executed by the Services and other agencies. These wargames are very helpful in identifying energy issues in the operating concepts of the Services, the operational plans of the Combatant Commands, and the various weapons and support platforms. Wargames scheduled to be conducted during FY 2021 with significant operational energy play include Army's Unified Quest 2021 and Air Force's Futures Game 2021. Furthermore, the Department will conduct its Joint Force Energy Wargame, set once again in the Indo-Pacific Command theater, in 2021.

Per 10 U.S.C. § 2911, the Department requires an energy key performance parameter and ESA for new programs. This analysis requires the Services to look at not merely the new system, but the associated infrastructure, concepts of operations, and future force structure. To account for programs with little or no impact on operational energy, the Joint Staff J-4 implemented a waiver process to relieve the Services of conducting unnecessary analyses. Examples of waived programs include non-deploying platforms, various munitions with self-contained energy (e.g., missiles), and permanent component replacements that consume no more power than the original component.

The Department continues to invest in several ongoing science and technology programs with the potential to increase the energy performance and capability of several major systems. These efforts translate directly to improved operational capabilities through increased range, payload, endurance, and time on station. With regard to operational energy, the Department is

particularly interested in directed energy platforms, improved energy storage capabilities, and improved engine technologies.

Energy is a fundamental enabler of military capability and the ability of the United States to project and sustain the power necessary for defense depends on the assured delivery of this energy. The Department remains committed to identifying, capturing, assessing, and mitigating risks to energy in the combat environment. Our focus is on increasing warfighter effectiveness through energy consideration of future platforms while enhancing the effectiveness of today's force by ensuring sufficient and timely delivery. Our primary methodology is through the use of wargames and energy supportability analysis, the latter now being required for all new weapons systems.

Prepared by Mr. Alan F. Bohnwagner, ODASD (E) / OASD (S), 703-614-0865

Approved by Ms. Lisa Jung, DASD for Energy / OASD (S), 571-372-6828

Appendix C. Estimated Expenditure and Requested Appropriations for OASD(S) and OUSD(R&E)

Pursuant to title 10, United States Code, section 2926, this appendix to the FY 2021 Budget Certification Report certifies and describes how the Assistant Secretary of Defense for Sustainment, in concert with Deputy Director for Research, Technology, and Laboratories, carries out duties related to operational energy. The FY 2021 President’s Budget provides \$4.0 million in Operation and Maintenance funding to support the functioning of ODASD(Energy). As noted on earlier in this report, the FY 2021 President’s Budget did not provide funding for OECIF . Reflecting the establishment of ODASD(Energy), a single program element now supports the policy and governance for both operational and installation energy.

Information contained in this table is also included in Appendix E to capture the total list of operational energy efforts.

Organization	Program Title	Operational Energy Strategy Objectives	Treasury Code	BA Code	Program Element	FY 2021 \$K
OASD(S)/ ODASD(Energy)	Operational Energy	Identify and Reduce Logistics and Operational Risks	100	04	0901388D8Z	6,095
Total						6,095

Appendix D. Fiscal Year 2021 Budget Fuel Estimates

Pursuant to title 10, United States Code, section 2926, this appendix to the FY 2021 Budget Certification Report certifies and describes how fuel prices for the Department are developed, stabilized, and, when necessary, adjusted due to market volatility.

The table below provides the Fuel Summary (\$ in Millions) for the Department’s Revolving Funds.

	FY 2019 ¹	Price Change ²	Program Change ³	FY 2020 Estimate ⁴	Price Change	Program Change	FY 2021 Estimate
Fuel	\$10,718.96	\$-335.75	\$510.33	\$10,893.54	\$-552.04	\$-60.43	\$10,281.08

1 Fuel is not a separate line item in DoD budgets or execution reports. The FY 2019 Actual column represents the cost to DoD customers at the executed standard price.

2 Price change calculated based on estimated sales at the budgeted price.

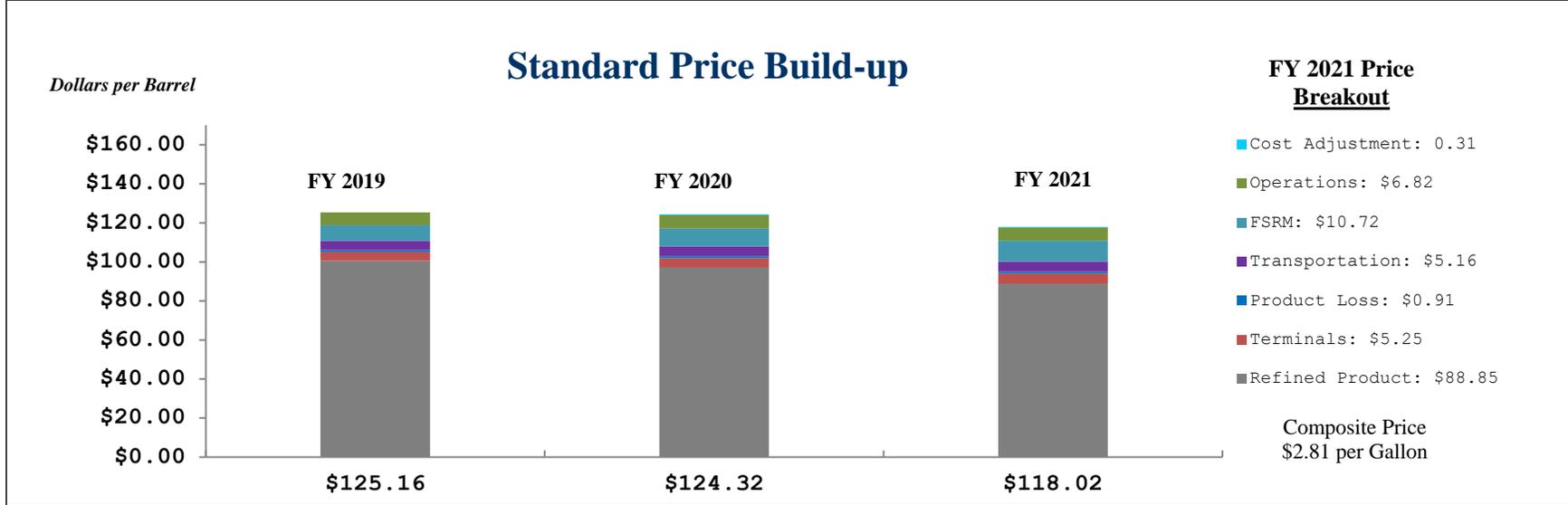
3 Program change calculated based on estimated sales at the budgeted price.

4 Fiscal Year (FY) estimate based on Defense Logistics Agency sales projections for both base and contingency operations.

The DLA is the sole-source fuel supplier for the Department of Defense. It is important to note that the Department purchases only refined products. The cost of refined fuel products constitutes nearly 80 percent of the price the DLA charges customers, so accuracy of the Office of Management and Budget’s forecasted petroleum market prices is key to maintaining stabilized rates in the budget year.

The Working Capital Fund’s (WCF) primary goal is to protect customer programs from fuel market volatility. Customers are charged standardized rates that assume fuel will remain relatively stable throughout the year of execution. Fuel price volatility can require funding reallocations that disrupt investment programs or threaten readiness, especially when budgets are declining in real terms and funds are increasingly limited.

The Department sets the price of fuel, typically 18 months in advance, to break even in the budget year by recouping the cost of refined products and the non-product costs of terminal operations, storage, transportation, facilities maintenance, and operations. The Department sets the standard fuel price based on the Administration’s economic assumptions for refined petroleum products plus the non-product price of the DLA’s projected operating costs. The “Standard Price Build-up” table shows the components actual standard price for FY 2019, the composite price for FY 2020, and the President’s Budget FY 2021 request.

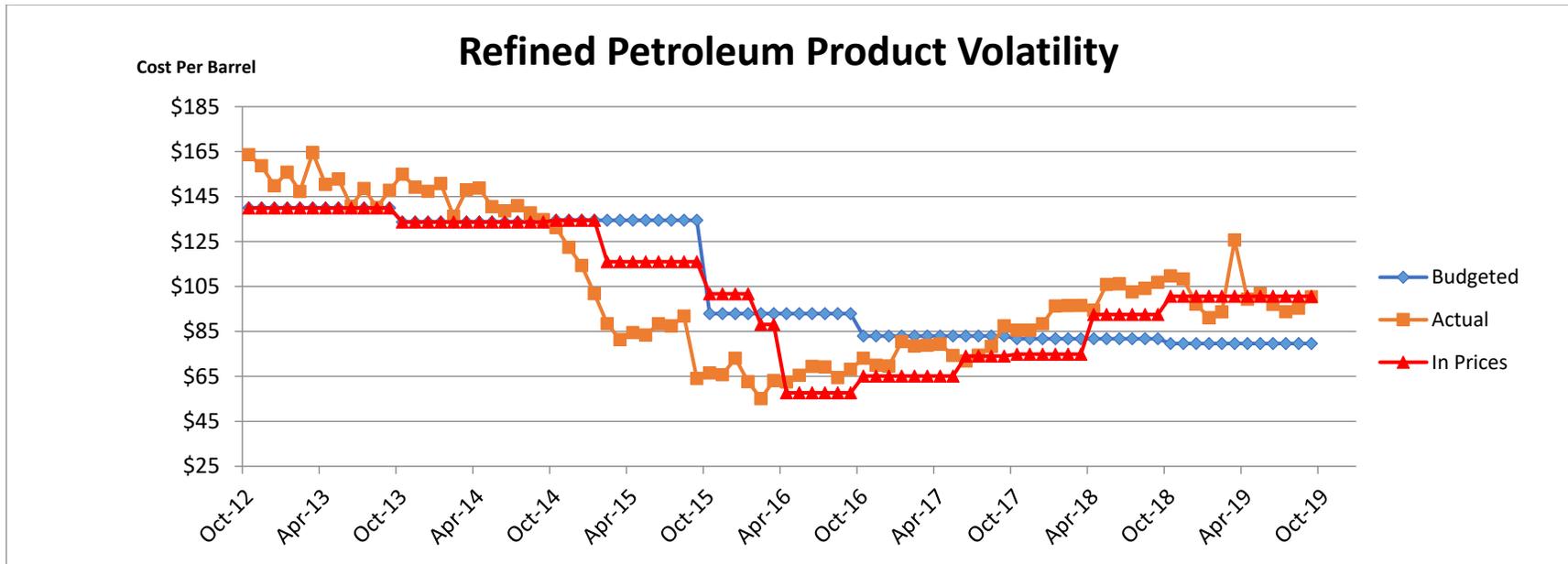


The refined petroleum market’s most volatile calendar years were 2008, 2009 and 2012. In the past ten fiscal years there were only two years (FY 2013 and FY 2014) in which the Department maintained the budgeted per barrel (bbl) fuel price level (\$156.66 bbl and \$152.04 bbl, respectively) throughout the year. Although there was no price change in FY 2014, the Department experienced higher than expected fuel costs and the WCF lost \$9.81 per barrel. The Department’s Defense-Wide WCF cash account was able to absorb the loss without a year of execution price change. Conversely, market volatility in FY 2015 and FY 2016 led to reduced fuel product costs, resulting in a cash surplus that the Department was able to reprogrammed \$1,205.7 million and \$2,001 million out of the Defense-Wide Working Capital Fund (DWWCF) to other Department accounts to support emerging requirements. In FY 2016, Congress also rescinded \$1,038 million due to the cash build-up in the DWWCF cash balance. As fuel cost continued to decline in FY 2017, Congress imposed a reduction to the Services’ budget of \$1 billion in the 2017 President’s Budget. In order to offset the Congressional reduction, the Department adjusted the rates on October 1, 2016, and on July 1, 2017, to absorb the reduction to the Services’ budget and help maintain readiness operations. Starting in FY 2018, fuel cost reversed direction and started to climb higher, but the Department held the Standard Fuel Price (SFP) charged to the Services at the FY 2017 level of \$90.30/bbl to mitigate any loss of operational readiness due to the

effects of the FY 2018 Continuing Resolution. As fuel cost continued to increase in FY 2018, the fuel price was changed on April 1, 2018 to \$115.92/bbl. The average fuel price for FY 2018 was \$103.11/bbl, which is \$1.47 below the budgeted fuel price of \$104.58/bbl. The average SFP charged to the Services in FY 2018 of \$103.11/bbl returned an estimated \$110.8 million in reductions taken from the Services' O&M appropriations in the 2018 Presidents' Budget; however, the lower SFP resulted in a decrease to the DWWCF cash balance as fuel cost outpaced the fuel price charged to the Services.

As fuel prices were expected to remain at FY 2018 levels into FY 2019, on October 1, 2019, the Department raised the fuel price to \$125.16/bbl, which is \$21 higher than the 2019 Presidents Budget fuel price of \$104.16/bbl to match the true cost of fuel expected in FY 2019. Also, in the FY 2019 Presidents' Budget, Congress added \$750 million to the Services O&M budget to mitigate higher than anticipated fuel costs. The FY 2020 SFP fuel price is \$124.32/bbl that is consistent with the SFP in the FY 2020 President's Budget.

The following chart illustrates the difficulty of setting prices that are sustainable for a full year, a year in advance of execution. The WCF loses cash whenever the cost of refined product (orange line) exceeds the refined product in prices (red line). Conversely, the WCF gains cash whenever the cost of refined product does not meet or exceed the refined product in prices.



The Defense-Wide WCF cash balance is the Department’s tool to stabilize DoD customer rates despite refined product market volatility. Cash balances must be sufficient in the Defense-Wide account to absorb the impact of market changes in the year of execution. When the market volatility exceeds the capacity of the Defense-Wide account to absorb or causes a large cash increase, the Department will seek additional funds through reprogramming or by instituting a year of execution price change. The price change can be either an upward or downward adjustment based on market projections. A downward adjustment will provide additional buying power to customers while an upward adjustment creates an execution year bill for customers.

The goal of the WCF and the Department is to maintain a stabilized price through the fiscal year to protect readiness and customer programs. Recognizing the volatility in the fuel market, the Department makes every effort to accurately project fuel prices and is seeking opportunities to stabilize the year of execution price. The Department reviews various options that range from modifying the formula used to develop the standard price to changing the benchmark source.

Appendix E. Fiscal Year 2021 Operational Energy Initiatives

Due to rounding, investment amounts may differ in the report.

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	Aerospace Power and Flight Control Technology	Aircraft Mechanical & Thermal Systems	Develop and advance technologies for Aircraft Mechanical & Thermal Systems	Increase Warfighter Capability	Power Controls and Distribution	3600	02	0602201F	9717
Air Force	Aerospace Propulsion	Adaptive Engine Transition Program (AETP)	Matures adaptive engine technologies through a maturation/risk reduction effort to design, fabricate, and test the first-ever complete, flight-weight adaptive engines in preparation for next-gen propulsion system development for multiple combat aircraft. Drives revolutionary progress necessary to guarantee future U.S. air superiority achieving +25% fuel efficiency, +10% thrust, significantly increased thermal capacity, and maintains full-life durability. **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	0604004F	636495
Air Force	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.	Increase Warfighter Capability	Platform Upgrades_Air	3600	03	0603033F	7731
Air Force	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	0603303F	1039

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	Aerospace Technology Development/ Demonstration	Megawatt Aircraft Power and Thermal	Develop and advance technologies for Megawatt Aircraft Power and Thermal	Increase Warfighter Capability	Platform Thermal Management	3600	03	0603303F	21734
Air Force	Aerospace Vehicle Technologies	Composite Certification	Develop, apply, and demonstrate methodology for verifying the reliability of composite structures as predicted to allow a more widespread use of composite structures to future systems such as Future Air Dominance and Next Generation Mobility.	Increase Warfighter Capability	Materials and Design	3600	02	0602201F	2742

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	Aerospace Vehicle Technologies	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	0602201F	1625
Air Force	Aerospace Vehicle Technologies	Electrical Power Systems	Technologies for robust, reliable, efficient power management and distribution.	Increase Warfighter Capability	Power Controls and Distribution	3600	02	0602201F	16149

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	Aerospace Vehicle Technologies	Fuel Assessment and Evaluation	Demonstrate fuels for performance, environmental impact and system operations	Reduce Logistics Risks to Mission	Platform Upgrades_Air	3600	02	0602201F	7467
Air Force	Aerospace Vehicle Technologies	Legacy Fleet Energy Efficiency	Develops fuel burn reduction technologies for the legacy and future fleets	Enhance Mission Effectiveness	Platform Upgrades_Air	3600	02	0602201F	503
Air Force	Defense Research Sciences	Dynamic Data and Information Processing	The portfolio seeks to extend the Dynamic Data Driven Applications Systems (DDDAS) framework with emphasis on the mathematical concepts that dynamically incorporate additional data, whether measured or from models, into an executing application, and in reverse, the ability to steer measurement collections, model refinements, and system awareness. Key developments should harness the use of first-principle models towards signals, data, and information processing substantial comparative improvements.	Increase Warfighter Capability	Power Controls and Distribution	3600	01	0601102F	5974
Air Force	Defense Research Sciences	Dynamic Materials and Interactions	The objective of this portfolio is to develop the fundamental scientific knowledge required to understand the dynamics of complex, heterogeneous and reactive materials for game-changing advancements in munitions and propulsion. The research areas supported by this portfolio therefore seek to discover, characterize, and reliably predict the fundamental chemistry, physics, hydrodynamics and materials science associated with the high energetics of explosives, solid propellant burning, and structural dynamics of materials subject to shock loading.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	4523

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	Defense Research Sciences	Energy, Combustion and Non-Equilibrium Thermodynamics	This portfolio addresses energy needs of Air Force aerospace systems for the propulsion and non-propulsive functions of increasingly significant energy requirements. The portfolio emphasizes three foundational elements: (1) Fundamental, (2) Relevant, and (3) Game-Changing, i.e.: starting from establishing fundamental scientific understanding and quantifying rate-controlling processes, focusing on Air Force interests and relevant conditions, encouraging multi-disciplinary collaborations, interactions and unconventional and innovative thinking, leading to game-changing concepts and predictive capabilities for the Air Force	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	6746
Air Force	Defense Research Sciences	GHz-THz Electronics and Materials	This program seeks scientific breakthroughs in materials, heterostructures, and devices that can lead to game-changing capabilities in RF sensing and amplification, transmit/receive functions, wideband operation, and novel functionalities. The primary frequencies of interest range from GHz to THz.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	5787

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	Defense Research Sciences	Low Density Materials	The 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 a multitude of load-bearing components and systems.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	6042
Air Force	Defense Research Sciences	Materials with Extreme Properties	This program focuses on understanding the fundamental atomic structure and microstructure, process, physical properties, and performance of materials in order to create novel materials with disruptive capabilities relevant for the Air Force. The objective is to discover scientific pathways to designing resilient materials with tailorable properties.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	7542
Air Force	Defense Research Sciences	Mechanics of Multifunctional Materials + Microsystems	The main goals of this program are (a) to integrate newly emerging materials, nanoscale devices and microsystems into multifunctional structures with revolutionary impact on multiple figures of merit and thereby (b) to enable the development and production of safer, more maneuverable aerospace vehicles and platforms with unprecedented performance characteristics for Air Force applications.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	6184
Air Force	Defense Research Sciences	Molecular Dynamics and Theoretical Chemistry	This program seeks a molecular-level description of reaction mechanisms and energy transfer processes related to the efficient storage and utilization of energy. The program supports cutting-edge experimental and joint theory-experiment studies that address key, fundamental questions in these areas. There are four major focus areas in the program: Catalytic Reactivity and Mechanisms; Novel Energetic Material Concepts; Dynamics of Energy Transfer and Transport; and Chemistry in Extreme Environments.	Increase Warfighter Capability	Propulsion Upgrades_Air	3600	01	0601102F	9641
Air Force	Defense Research Sciences	Organic Materials Chemistry	The goal of this research area is to achieve novel and useful properties and behaviors from polymeric and organic materials, and their organic/inorganic hybrids based on better understanding of their chemistry, physics, and processing conditions. This understanding will lead to development of advanced organic, hybrid, and polymeric materials for future U.S. Air Force applications.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	6389

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	Defense Research Sciences	Plasma and Electro-Energetic Physics	This program seeks to provide revolutionary advances in the fundamental understanding of underlying physical processes necessary to control the interaction of electromagnetic energy and charged particles to 1) produce useful work for a variety of applications, including directed energy weapons, sensors and radar, electronic warfare, communications, and novel compact accelerators, or to 2) improve our ability to operate in a range of extreme environments and conditions. The focus of this portfolio is split between exploratory plasma physics and the basic science associated with the generation and collective interaction of electromagnetic fields and plasmas.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	8995
Air Force	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 sensing elements.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	5153
Air Force	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, Nano-energetics in solid propellant combustion, High Pressure Combustion Dynamics in rocket engines, and structural batteries.	Increase Warfighter Capability	Materials and Design	3600	01	0601102F	4567
Air Force	Defense Research Sciences	Unsteady Aerodynamics and Turbulent Flows	The Unsteady Aerodynamics and Turbulent Flows portfolio supports basic research into the dynamics and control of aerodynamic shear flows including the interactions of these flows with rigid and flexible surfaces in motion. The portfolio is interested in aerodynamic flows arising in both internal and external configurations and extending over a wide range of Reynolds numbers. The portfolio emphasizes the characterization, modeling, prediction, and control of flow instabilities, turbulent flows, and aerodynamic interactions.	Increase Warfighter Capability	Platform Upgrades_Air	3600	01	0601102F	4812
Air Force	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	4533
Air Force	Materials	Flexible Materials and Processing Research Team	Dev lightweight, flexible, and integrated mtl solutions for adv thin film energy harvesting and storage devices and integrated flexible electronic components. Applications include lightweight power for deployed operations, mechanically robust electronics, and devices for human perf monitoring.	Increase Warfighter Capability	Materials and Design	3600	02	0602102F	2693

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	University Research Initiative	URI - Dynamic Data and Information Processing	MURI, DURIP, and PECASE efforts executed under the Dynamic Data and Information Processing program	Increase Warfighter Capability	Power Controls and Distribution	3600	01	0601103F	218
Air Force	University Research Initiative	URI - Dynamic Materials and Interactions	MURI, DURIP, and PECASE efforts executed under the Dynamic Materials and Interactions program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	1635
Air Force	University Research Initiative	URI - GHz-THz Electronics and Materials	MURI, DURIP, and PECASE efforts executed under the GHz-THz Electronics and Materials	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	2671
Air Force	University Research Initiative	URI - Materials with Extreme Properties	MURI, DURIP, and PECASE efforts executed under the Materials with Extreme Properties program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	4105
Air Force	University Research Initiative	URI - Mechanics of Multifunctional Materials + Microsystems	MURI, DURIP, and PECASE efforts executed under the Mechanics of Multifunctional Materials + Microsystems program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	1853
Air Force	University Research Initiative	URI - Molecular Dynamics and Theoretical Chemistry	MURI, DURIP, and PECASE efforts executed under the Molecular Dynamics and Theoretical Chemistry program	Increase Warfighter Capability	Propulsion Upgrades_Air	3600	01	0601103F	1853
Air Force	University Research Initiative	URI - Plasma and Electro-Energetic Physics	MURI, DURIP, and PECASE efforts executed under the Plasma and Electro-Energetic Physics program	Increase Warfighter Capability	Materials and Design	3600	01	0601103F	3682
Air Force	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	2065

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
Air Force	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	1635
Space Force	Space Solar Power	Space-Based Power Generation	Space-Based Power Generation for Operational Users	Increase Warfighter Capability	Materials and Design	3600	04	1206857SF	85880
								Air & Space Forces Total	\$900,850

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
ARMY	Defense Research Sciences	Robotics and Mobile Energy 01	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	1226
ARMY	Defense Research Sciences	Robotics and Mobile Energy 02	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	6266
ARMY	Defense Research Sciences	Robotics and Mobile Energy 03	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	1540
ARMY	Defense Research Sciences	Robotics and Mobile Energy 04	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	1000
ARMY	Defense Research Sciences	Robotics and Mobile Energy 05	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	3000
ARMY	Defense Research Sciences	Robotics and Mobile Energy 06	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	1515
ARMY	Defense Research Sciences	Robotics and Mobile Energy 07	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	2556

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
ARMY	Defense Research Sciences	Robotics and Mobile Energy 08	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	1236
ARMY	Defense Research Sciences	Robotics and Mobile Energy 09	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	778
ARMY	Defense Research Sciences	Robotics and Mobile Energy 10	basic research in robotic and mobile energy	Increase Warfighter Capability	Platform Upgrades_Land	2040	01	0601102A	3700
ARMY	Soldier Lethality Technology	Soldier & Sm Unit Tactical Energy Tech 06	Applied research in Soldier & Sm Unit Tactical Energy Tech	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602143A	3700
ARMY	Soldier Lethality Technology	Soldier & Sm Unit Tactical Energy Tech 68	Applied research in Soldier & Sm Unit Tactical Energy Tech	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602143A	945
ARMY	Soldier Lethality Technology	Soldier & Sm Unit Tactical Energy Tech 83	Applied research in Soldier & Sm Unit Tactical Energy Tech	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602143A	3162
ARMY	Soldier Lethality Technology	Soldier & Sm Unit Tactical Energy Tech 90	Applied research in Soldier & Sm Unit Tactical Energy Tech	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602143A	1245
ARMY	Ground Technology	Segmented Composite Track and Strut Suspension 12	Applied research in Segmented Composite Track and Strut Suspension	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	1530
ARMY	Ground Technology	Diesel Electric Power Generator 15	Applied research in Diesel Electric Power Generator	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	2200
ARMY	Ground Technology	Beyond Lithium-Ion Energy Storage 16	Applied research in Beyond Lithium-Ion Energy Storage	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	1174

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
ARMY	Ground Technology	High Voltage Modular Li-Ion Battery 17	Applied research in High Voltage Modular Li-Ion Battery	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	2078
ARMY	Ground Technology	Electric Drive Motors/Power Controllers/Conv 18	Applied research in Electric Drive Motors/Power Controllers/Conv	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	02	0602145A	2100
ARMY	Ground Technology	Scaleable Electrification & Control Architecture 19	Applied research in Scaleable Electrification & Control Architecture	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	2000
ARMY	Ground Technology	Power Electronic Components and Materials 20	Applied research in Power Electronic Components and Materials	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	2572
ARMY	Ground Technology	New Task (\$ from Battlefield Hydrogen) 21	Applied research in New Task (\$ from Battlefield Hydrogen)	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	4204
ARMY	Ground Technology	Advanced Distributed Power for Autonomous Systems 22	Applied research in Advanced Distributed Power for Autonomous Systems	Increase Warfighter Capability	Platform Upgrades_Land	2040	02	0602145A	1567
ARMY	Network C3I Technology	Energy Efficient Devices Technology 84	Applied research in Energy Efficient Devices Technology	Increase Warfighter Capability	Individual/Warfighter Power	2040	02	0602146A	5478
ARMY	Future Vertical Lift Technology	Future UAS Engine Technology 01	Applied research in Future UAS Engine Technology	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	02	0602148A	3054
ARMY	Future Vertical Lift Technology	High Reduction-Ratio Transmission (HRT) 63	Applied research in High Reduction-Ratio Transmission (HRT)	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	02	0602148A	4126
ARMY	Future Vertical Lift Technology	Opt Energy Stg & Therm Mgmt for FVL Survivability 07U	Applied research in Opt Energy Stg & Therm Mgmt for FVL Survivability	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	02	0602148A	4953
ARMY	Future Vertical Lift Technology	Power & Thermal Management Tech Demo 08	Applied research in Power & Thermal Management Tech Demo	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	02	0602148A	3730
ARMY	Soldier Lethality Advanced Technology	Soldier & Sm Unit Tactical Energy AdvTech 46	Advanced technology development in Soldier & Sm Unit Tactical Energy AdvTech	Increase Warfighter Capability	Individual/Warfighter Power	2040	03	0603118A	3163
ARMY	Ground Advanced Technology	Fuel Contamination Limits for Ground Systems 54	Advanced technology development in Fuel Contamination Limits for Ground Systems	Increase Warfighter Capability	Platform Upgrades_Land	2040	03	0603119A	400

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
ARMY	Ground Advanced Technology	Enhanced Jet Fuel for Ground System Durability 56	Advanced technology development in Enhanced Jet Fuel for Ground System Durability	Increase Warfighter Capability	Platform Upgrades_Land	2040	03	0603119A	350
ARMY	Next Generation Combat Vehicle Advanced Technology	Electric Drive Motors/Power Controllers/Conv 07	Advanced technology development in Electric Drive Motors/Power Controllers/Conv	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	03	0603462A	740
ARMY	Next Generation Combat Vehicle Advanced Technology	Diesel Electric Power Generator 09	Advanced technology development in Diesel Electric Power Generator	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	03	0603462A	2084
ARMY	Next Generation Combat Vehicle Advanced Technology	High Voltage Modular Li-Ion Battery 10	Advanced technology development in High Voltage Modular Li-Ion Battery	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	03	0603462A	1100
ARMY	Next Generation Combat Vehicle Advanced Technology	AVPTA - Electrification Technology 11	Advanced technology development in AVPTA - Electrification Technology	Increase Warfighter Capability	Propulsion Upgrades_Land	2040	03	0603462A	2097
ARMY	Next Generation Combat Vehicle Advanced Technology	Highly Electrified and Autonomous Platforms - GVSC/AAL 15	Advanced technology development in Highly Electrified and Autonomous Platforms - GVSC/AAL	Increase Warfighter Capability	Platform Upgrades_Land	2040	03	0603462A	2787
ARMY	Next Generation Combat Vehicle Advanced Technology	Highly Electrified and Autonomous Platforms - GVSC/AAL 16	Advanced technology development in Highly Electrified and Autonomous Platforms - GVSC/AAL	Increase Warfighter Capability	Platform Upgrades_Land	2040	03	0603462A	7617
ARMY	Next Generation Combat Vehicle Advanced Technology	Advanced Slip Ring 03	Advanced technology development in Advanced Slip Ring	Increase Warfighter Capability	Platform Upgrades_Land	2040	03	0603462A	2113
ARMY	Future Vertical Lift Advanced Technology	Alternative Concept Engine Advanced Technology 07	Advanced technology development in Alternative Concept Engine Advanced Technology	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	03	0603465A	2604
ARMY	Future Vertical Lift Advanced Technology	Future UAS Engine Advanced Technology 08	Advanced technology development in Future UAS Engine Advanced Technology	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	03	0603465A	2830
ARMY	Future Vertical Lift Advanced Technology	Power & Thermal Management Technology 01	Advanced technology development in Power & Thermal Management Technology	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	03	0603465A	2000
ARMY	Inland Petroleum Distribution System	Fuel Infrastructure	IPDS Fuel Unit COSIS	Reduce Logistics	Fuel Infrastructure	2020	02	0208031A	21852.633

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
				Risks to Mission					
ARMY	Abrams Upgrade Program	Improved Abrams	Power Initiative for Abrams M1A2SEPV3 (Power ECP) vehicle	Increase Warfighter Capability	Platform Upgrades_Land	2033	01	0211702A	9083
ARMY	Abrams Upgrade Program	Improved Abrams	Advance Reliability & Cost Savings (ARCS) for the AGT-1500 Turbine Engine	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2033	01	0211702A	2300
ARMY	Generators and Associated Equipment	Advanced Medium Mobile Power Source	Advanced Medium Mobile Power Sources (AMMPS) Power Units/Mounted	Increase Warfighter Capability	Contingency Basing	2035	03	0216300A	17289
ARMY	Tractor, Full Tracked	Construction Equipment Virtual Trainer (CEVT)	Construction Equipment Virtual Trainer (CEVT)	Enhance Mission Effectiveness	Simulators Land	2035	03	0219900A	4720
ARMY	Grader, Road	Construction Equipment Virtual Trainer (CEVT)	Construction Equipment Virtual Trainer, Grader, Road MTZD, HVY, 6x4 (CCE)	Enhance Mission Effectiveness	Simulators Land	2035	03	0219900A	5412
ARMY	Loaders	Construction Equipment Virtual Trainer (CEVT)	Construction Equipment Virtual Trainer (CEVT) Loaders	Enhance Mission Effectiveness	Simulators Land	2035	03	0219900A	4526
ARMY	Hydraulic Excavator	Construction Equipment Virtual Trainer (CEVT)	Construction Equipment Virtual Trainer (CEVT), Hydraulic Excavator	Enhance Mission Effectiveness	Simulators Land	2035	03	0219900A	4192
ARMY	Joint Light Tactical Vehicle	Electrical System Energy Related Improvements - Engine Upgrade	Electrical System Energy Related Improvements - Engine Upgrade	Enhance Mission Effectiveness	Contingency Basing	2040	05	0605812A	50
ARMY	Joint Light Tactical Vehicle	Electrical System Energy Related Improvements - Engine Upgrade	Electrical System Energy Related Improvements - Engine Upgrade	Enhance Mission Effectiveness	Contingency Basing	2035	01	0216300A	126468
ARMY	Joint Light Tactical Vehicle	Electrical System Energy Related Improvements - Alternator and Li Battery	Electrical System Energy Related Improvements - Alternator and Li Battery	Enhance Mission Effectiveness	Contingency Basing	2035	01	0216300A	10282
ARMY	AH-64 Apache Block IIIA REMAN (AP-CY)	Apache Simulator	Apache Simulator, AH-64 Apache Block IIIA REMAN (AP-CY)	Enhance Mission Effectiveness	Simulators Aviation	2031	01	0210100A	6810
ARMY	Armored Multi-Purpose Vehicle (AMPV)	Armored Multi-Purpose Vehicle (AMPV)	Armored Multi-Purpose Vehicle (AMPV)	Increase Warfighter Capability	Propulsion Upgrades_Land	2033	01	0211702A	229671

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
ARMY	Improved Turbine Engine	Aviation - Improved Turbine Engine Program (ITEP)	Aviation - Improved Turbine Engine Program (ITEP)	Increase Warfighter Capability	Propulsion Upgrades_Air	2040	07	0607139A	249500
ARMY	UH-60 Black Hawk M Models	Black Hawk Aircrew Simulators	Black Hawk Aircrew Simulators	Enhance Mission Effectiveness	Simulators Aviation	2031	01	0210101A	28900
ARMY	UH-60 Black Hawk A and L Models	Black Hawk Aircrew Simulators	Black Hawk Aircrew Simulators	Enhance Mission Effectiveness	Simulators Aviation	2031	01	0210101A	11118
ARMY	Aviation Ground Support Equipment	Next Generation Aviation Ground Power Unit (NGAGPU)	Next Generation Aviation Ground Power Unit (NGAGPU)	Increase Warfighter Capability	Contingency Basing	2040	05	0605830A	1468
ARMY	Engine-Driven Generators Engineering Development	Power Distribution Illumination Systems Electrical (PDISE) Expansion	Power Distribution Illumination Systems Electrical (PDISE) Expansion	Increase Warfighter Capability	Contingency Basing	2040	05	0604804A	1800
ARMY	Generators and Associated Equipment	Power Distribution Illumination Systems Electrical (PDISE) Expansion	Power Distribution Illumination Systems Electrical (PDISE) Expansion	Increase Warfighter Capability	Contingency Basing	2035	03	0216300A	7800
ARMY	Integrated Soldier Power Data System - Core	Small Unit Tactical Power (ISPDS-C)	Small Unit Tactical Power (ISPDS-C)	Increase Warfighter Capability	Individual/Warfighter Power	2040	05	0604827A	4281
ARMY	Universal Battery Charger	Small Unit Tactical Power (ISPDS-C)	Small Unit Tactical Power (ISPDS-C)	Enhance Mission Effectiveness	Individual/Warfighter Power	2040	05	0604827A	1000
ARMY	Mobile Soldier Power	Integrated Soldier Power Data System - Core (ISPDS-C)	ISPDS-C	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A	17837
ARMY	Universal Battery Charger	Integrated Soldier Power Data System - Core (ISPDS-C)	ISPDS-C	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A	10076
ARMY	Ground Soldier systems	Small Unit Tactical Power (ISPDS-C)	Small Unit Tactical Power (ISPDS-C) Nett Warrior	Enhance Mission Effectiveness	Individual/Warfighter Power	2035	03	0211700A	40615
ARMY	Engine-Driven Generators Engineering Development	Small Tactical Electric Power (STEP)	Small Tactical Electric Power (STEP)	Increase Warfighter Capability	Contingency Basing	2040	05	0604804A	8800
ARMY	Engine-Driven Generators	Small Tactical Electric Power (STEP)	Small Tactical Electric Power (STEP)	Increase Warfighter Capability	Contingency Basing	2040	05	0604804A	8800

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
	Engineering Development								
ARMY	Generators and Associated Equipment	Small Tactical Electric Power (STEP)	Small Tactical Electric Power (STEP)	Increase Warfighter Capability	Contingency Basing	2035	03	0216300A	9400
ARMY	Combat Vehicle Improvement	Stryker Non-Primary Power Capability Enhancement	Stryker Non-Primary Power Capability Enhancement	Enhance Mission Effectiveness	Metering and Monitoring	2040	07	0203735A	3000
ARMY	Water and Petroleum Distribution - ED	Early Entry Fluid Distribution System (E2FDS)	Early Entry Fluid Distribution System (E2FDS)	Reduce Logistics Risks to Mission	Fuel Infrastructure	2040	05	0604804A	1640
ARMY	Distribution Systems, Petroleum & Water	Early Entry Fluid Distribution System (E2FDS)	Early Entry Fluid Distribution System (E2FDS)	Reduce Logistics Risks to Mission	Fuel Infrastructure	2035	03	0216300A	20793
ARMY	Distribution Systems, Petroleum & Water	Bulk Fuel Distribution System	Bulk Fuel Distribution System	Reduce Logistics Risks to Mission	Fuel Infrastructure	2040	05	0604804A	500
ARMY	Distribution Systems, Petroleum & Water	Bulk Fuel Distribution System	BFDS - Bulk Fuel Distribution System	Reduce Logistics Risks to Mission	Fuel Infrastructure	2035	03	0216300A	17100
ARMY	Bradley Program (MOD)	Improved Bradley	Increases mobility with extended life track, and improved shocks, road arms and torsion bars	Enhance Mission Effectiveness	Platform Upgrades_Land	2033	01	0211702A	76475
ARMY	Bradley Program (MOD)	Improved Bradley	More efficient Bradley - The Bradley improved engine and transmission generate an overall fuel reduction of 3%	Increase Warfighter Capability	Propulsion Upgrades_Land	2033	01	0211702A	31371
ARMY	Paladin PIM MOD In Service	M109 Family of Vehicles (FOV) Paladin Integrated Management (PIM)	Powertrain and electrical system upgrades	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2033	01	0210609A	435825
ARMY	Stryker Improvement	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network.	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2040	07	0202123A	28607
ARMY	Stryker Upgrade	Improved Stryker	More efficient Stryker, increased horsepower, electrical output, upgraded suspension, and in-vehicle network	Enhance Mission Effectiveness	Propulsion Upgrades_Land	2033	01	0202123A	354779
								Total Army	1,916,661

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
DLA	Battery Network (BATTNET)	BATTNET	Battery Network (BATTNET) is one element of DLA's Improving Industrial Base Manufacturing Processes' strategic focus area and will improve the supply and reduce 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 relies on a community of battery supply chain members, engineering support activities, researchers, and users to conduct research and development on sustainment issues or risks, and bridge technical solutions for specific groups of batteries.	Reduce Logistics Risks to Mission	Alternative Power Sources	0400	03	0603680s	4065
DLA	Energy Readiness Program	ERP	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	Alternative Fuels Certification and Testing	0400	03	0603712S	2186
OSD	Office of the Deputy Assistant Secretary of Defense for Energy	Operations & Maintenance	OSD Senior Officials for Operational Energy. Tasked to analyze, develop and direct OE's energy strategy.	Increase Future Warfighting Capability		0100	04	0901388D8Z	4908
OSD	Operational Energy Capability Improvement Fund	OECIF	Fund innovation to improve DoD operational effectiveness via targeted investments in operational energy S&T. Two key elements: 1) Develop operational energy technologies and practices to improve DoD military capabilities; 2) Establish within the Services institutional momentum to continue those innovations. OECIF provides "seed money" to start or consolidate promising operational energy research programs.	Increase Warfighter Capability		0400	03	060455D8Z	0
								Total DLA and OSD	11,159

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
NAVY	ENERGY CONSERVATION	Energy Monitoring & Assessment	Develops 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.	Enhance Mission Effectiveness	Metering and Monitoring	1319	04	0603724N	4776
NAVY	ENERGY CONSERVATION	Afloat Hull Hydrodynamics	Development, modeling, laboratory and Fleet testing of ship modifications to propellers such as fouling release coatings and hull appendages to determine overall mission and cost effectiveness of these improvements.	Enhance Mission Effectiveness	Platform Upgrades_Sea	1319	04	0603724N	735
NAVY	ENERGY CONSERVATION	Afloat Power Generation and Storage	Development, laboratory and Fleet testing to determine overall mission and cost effectiveness of improved power generation and storage technologies.	Increase Warfighter Capability	Platform Upgrades_Sea	1319	04	0603724N	300
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.	Reduce Logistics Risks to Mission	Platform Upgrades_Sea	1319	04	0603564N	374
NAVY	OPERATIONAL LOGISTICS	Seabased Petroleum Distribution System (SPDS)	SPDS is a minimally manned bulk fuel cache that provides bulk fuel over the shore in austere environments. This project will develop a scaled prototype and two operational full-scale prototypes.	Reduce Logistics Risks to Mission	Fuel Infrastructure	1319	04	0603564N	13000
NAVY	OPERATIONAL LOGISTICS	Joint Off Shore Fuel Farm (JOFF)	JOFF is a minimally manned to automated fuel cache to resupply oilers and combatants in open ocean uncontested waters and to supply fuel over the shore in support of Expeditionary Advanced Base Operations (EABO). This project will develop the larger open ocean JOFF and smaller EABO support JOFF and produce functional prototypes.	Reduce Logistics Risks to Mission	Fuel Infrastructure	1319	04	0603564N	348
NAVY	OPERATIONAL LOGISTICS	Modular CONSOL Adapter Kit (MCAK)	The MCAK, when attached to a fuel carrying vessel, allows oilers to connect and be replenished underway. This project will develop the MCAK which can be deployed and fitted on to tankers and OSVs to increase options for refueling oilers in a distributed maritime environment.	Reduce Logistics Risks to Mission	Fuel Infrastructure	1319	04	0603564N	650

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
NAVY	OPERATIONAL LOGISTICS	Improved Modular Fuel Delivery System (IMFDS)	IMFDS, when attached to a fuel carrying vessel, allows it to refuel combatants while underway. This project will develop the iMFDS which will be deployed to tankers and OSVs for additional underway replenishment options in the distributed maritime environment.	Reduce Logistics Risks to Mission	Fuel Infrastructure	1319	04	0603564N	3850
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	1854
NAVY	DEFENSE RESEARCH SCIENCES	ONRG International Research	Basic research with international principle investigators doing collaborative and cooperative research with the Naval research enterprise.	Increase Warfighter Capability	Alternative Power Sources	1319	01	0601153N	200
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	1848
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	2464
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	8808

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
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	2532
NAVY	DEFENSE RESEARCH SCIENCES	Naval Biosciences - Microbial 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. Program focuses on study of fundamental mechanisms used for extracellular electron transport.	Increase Warfighter Capability	Alternative Power Sources	1319	01	0601153N	600
NAVY	DEFENSE RESEARCH SCIENCES	Bioengineering and Life Sciences (Energy)	Basic research exploring bio fabrication for generation of inorganic energy harvesting/conversion materials; bacterial-inorganic hybrid materials for fuel cells; nano-biomaterials for generating high intensity light sources; silk composites for energy harvesting and energy sources; and novel humidity responsive materials for harnessing energy from natural evaporation.	Increase Warfighter Capability	Materials and Design	1319	01	0601153N	634
NAVY	DEFENSE RESEARCH SCIENCES	Bioengineering and Life Sciences (Energy)	Basic research exploring the fundamental mechanism of bacterial spores' water-responsive behaviors in order to develop practical applications using the evaporation energy harvesting technique, and next generation actuators.	Increase Warfighter Capability	Alternative Power Sources	1319	01	0601153N	103
NAVY	DEFENSE RESEARCH SCIENCES	NRL Energy - Alternative Power Basic Research	Long term Basic research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Alternative Power Sources	1319	01	0601153N	5517

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
NAVY	DEFENSE RESEARCH SCIENCES	NRL Energy - Materials and Design Basic Research	Long term Basic 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	Materials and Design	1319	01	0601153N	2385
NAVY	DEFENSE RESEARCH SCIENCES	NRL Energy - Alternative Fuels Basic Research	Long term Basic 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 Production	1319	01	0601153N	490
NAVY	POWER PROJECTION APPLIED RESEARCH	NRL Energy - Individual Warfighter Power Basic Research	Long term Basic 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	1251
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.	Enhance Mission Effectiveness	Propulsion Upgrades_Air	1319	02	0602123N	8685

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
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	3615
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	959
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	11274
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	16238
NAVY	FORCE PROTECTION APPLIED RESEARCH	NRL Energy - Alternative Power Sources Applied Research	Long term Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Alternative Power Sources	1319	02	0602123N	1065

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
NAVY	FORCE PROTECTION APPLIED RESEARCH	NRL Energy - Power Controls and Distribution Applied Research	Long term 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	Power Controls and Distribution	1319	02	0602123N	1689
NAVY	WARFIGHTER SUSTAINMENT APPLIED RESEARCH	ONRG International Research	Early applied research with international principle investigators doing collaborative and cooperative research with the Naval research enterprise.	Increase Warfighter Capability	Alternative Power Sources	1319	02	0602236N	150
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/submarine wastewater degradation	Reduce Logistics Risks to Mission	Alternative Power Sources	1319	02	0602236N	897
NAVY	WARFIGHTER SUSTAINMENT APPLIED RESEARCH	Bioengineering and Life Sciences (Energy)	Applied research to develop practical full fuel cell devices implementing (1) novel oxygen reduction reaction (ORR) catalysts, that show record high half-cell performance in a laboratory setting, and (2) novel supports for these platinum-based ORR catalysts.	Increase Warfighter Capability	Materials and Design	1319	02	0602236N	170
NAVY	OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	NRL Energy - Ocean Warfighting Alternative Power Basic Research	Long term Applied research into phenomena and mechanisms allowing for more efficient conversion of power; generation of power from solar illumination; from hydrogen conversion in fuel cells; storage of energy in improved battery technologies; augmentation of liquid fuels for greater energy density and exploitation of biological mechanisms for long-duration energy sources.	Increase Warfighter Capability	Alternative Power Sources	1319	02	0602435N	1237
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.	Increase Warfighter Capability	Propulsion Upgrades_Sea	1319	02	0602747N	1200

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
			Approaches include modeling and simulation, fuel cells, engines, novel fuels/oxidizers and reactant storage/delivery systems.						
NAVY	FUTURE NAVAL CAPABILITIES APPLIED RESEARCH	Robust Combat Power Control	Develop Combat Power and Energy Control System to anticipate, align and configure shipboard resources based on system state and mission context.	Increase Warfighter Capability	Power Controls and Distribution	1319	02	0602750N	5640
NAVY	AIRCRAFT ENERGY	Common Affordable Safe Energy Storage	Optimize aircraft battery performance, safety and cost through development of a common, scalable LI-I battery	Increase Warfighter Capability	Individual/Warfighter Power	1319	04	0603724N	1480
NAVY	AIRCRAFT ENERGY	Aircraft Turbine Engine Recuperator	Demonstrate using M250 engine utilizing an advanced recuperator design enabling 25% reduced specific fuel consumption (SFC). Reduced SFC would provide extended time on station improvement of 25 - 35%, critical to ISR mission.	Enhance Mission Effectiveness	Propulsion Upgrades_Air	1319	04	0603724N	1200
NAVY	AIRCRAFT ENERGY	Aircraft Splitter Rotor Compressor	Development and validation of advance compressor design to increase efficiency and reduce weight	Enhance Mission Effectiveness	Propulsion Upgrades_Air	1319	04	0603724N	100
NAVY	AIRCRAFT ENERGY	Aviation On-Board Thermal Management	Demonstrate deoxygenation technology to increase fuel heat sink capability in order to maximize aircraft thermal management and increase engine efficiency	Enhance Mission Effectiveness	Platform Thermal Management	1319	04	0603724N	2000
NAVY	AIRCRAFT ENERGY	Aircraft Integrated Thermal and Power Management Modelling	Development and validation of Integrated Power and thermal management models to develop integrated solutions in legacy and emerging platforms	Enhance Mission Effectiveness	Platform Thermal Management	1319	04	0603724N	1600
NAVY	AIRCRAFT ENERGY	Aviation High Efficiency Generator	Evaluate and demonstrate alternative aircraft power generation/conversion technologies to provide more efficient power generation to meet legacy platform power deficiencies	Enhance Mission Effectiveness	Propulsion Upgrades_Air	1319	04	0603724N	900
NAVY	AIRCRAFT ENERGY	Air ENCON	Develop, validate and socialize tools to utilize available datasets (aircraft and pilot generated) to model aircraft flying trends to identify opportunities for improvement in order to maximize operation capability.	Enhance Mission Effectiveness	Current Operations Tools	1319	04	0603724N	350

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
NAVY	AIRCRAFT ENERGY	Aviation Operational Modeling and Simulation	Leverage modeling, simulation and data sources to develop assessments and tools to support operational capability assessments	Increase Warfighter Capability	M&S, Studies, and Wargames	1319	04	0603724N	250
NAVY	AIRCRAFT ENERGY	Aviation Opportunity Studies	Provide seed funding to investigate potential aircraft Operational Energy solutions and identify potential candidates to select for detailed projects.	Enhance Mission Effectiveness	Platform Upgrades_Air	1319	04	0603724N	389
NAVY	MOBILITY FUELS	Deployed Sensor Development and Validation	Develop and validate technology to reduce time and resources necessary to provide fuel quality surveillance in forward deployed environments	Reduce Logistics Risks to Mission	Metering and Monitoring	1319	04	0603724N	1400
NAVY	MOBILITY FUELS	Interoperability with Commercial and Allied forces	Conduct RDTE necessary to assure that Naval tactical forces (air, sea and ground) can operate seamlessly using allied and commercially procured fuels	Reduce Logistics Risks to Mission	Conventional Fuels Testing	1319	04	0603724N	900
NAVY	MOBILITY FUELS	Rapid fuel analysis and impact assessment	Develop test methods, fuel-hardware interaction correlations and analytic tools to reduce operational impacts from field identified deficiencies	Reduce Logistics Risks to Mission	Conventional Fuels Testing	1319	04	0603724N	2763
NAVY	MOBILITY FUELS	Fuel Hardware Impact analysis	Conduct RDTE necessary to allow operational and technical decision makers the ability to assess risk of fuel properties/chemistry on current and emerging operational or platform requirements	Reduce Logistics Risks to Mission	Conventional Fuels Testing	1319	04	0603724N	2400
NAVY	ADVANCE SURFACE MACHINERY SYS	Integrated Power & Energy Systems	Development of Next Generation Integrated Power and Energy System (NGIPES) technology aboard Navy Ships to enable current and future weapons and sensor systems.	Increase Warfighter Capability	Power Controls and Distribution	1319	04	0603573N	32056

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
NAVY	MQ-25	MQ-25 Development	Development of first CVN-based organic mission and recovery tanker. MQ-25 will extend the range and increase lethality of the CSG's CVW, and will contribute to F/A-18EF shortfall by relieving tanker duties and returning a/c to the strike fighter role. MQ-25 will also have a secondary ISR capability. IOC 4QFY24.	Reduce Logistics Risks to Mission	Mobile Fuel Assets	1319	05	0605414N	213558
NAVY	KNIFEFISH	Knifefish Fuel Cell FNC	Develop and demonstrate—initially in a laboratory environment-- a PEM based fuel cell system integrated into a Knifefish shell section. The fuel cell to system is designed to provide additional power and increase endurance over the current Knifefish Li-ion battery for the Knifefish vehicle.	Increase Warfighter Capability	Alternative Power Sources	1319	04	0604028N	5697.25
NAVY	UNMANNED UNDERSEA VEHICLE (UUV) CORE TECHNOLOGIES	Advanced Undersea Prototyping Aluminum-Water Combustor	Follow on effort to the OECIF AI-Water for UUVs Program in order to right-size the combustor for operations and integration in an UUV with requirements of a lower power combustor, advanced stop/start capability, and higher technologically advanced design readiness level for each component. This will require pushing technological advancement in multiple disciplines. The completed design will allow for an air independent energy alternative as a safe, high energy density (significantly greater than Li-ion) energy solution. This technology will operate with a safe, non-flammable, fuel source that increases warfighter capability in endurance and stealth as compared to the current diesel electric variant.	Increase Warfighter Capability	Alternative Power Sources	1319	04	0604029N	1100
NAVY	UNMANNED UNDERSEA VEHICLE (UUV) CORE TECHNOLOGIES	Li-Ion Battery: Propagation Resistant Architecture	Project is focused on the development of a propagation resistant battery architecture including integration and demonstration in a medium sized UUV. Effort also includes modeling and simulation capabilities geared toward predicting the propagation resistance of a battery architecture.	Increase Warfighter Capability	Propulsion Upgrades_Sea	1319	04	0604029N	8330

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NAVY	UNMANNED UNDERSEA VEHICLE (UUV) CORE TECHNOLOGIES	Li-ion EARly fault Predictive Monitor (LEAP-M)	Development and integration of Li-ion predictive monitoring system to identify potential hazardous internal shorts before they pose a hazard, allowing for safing/removal from services prior to a battery casualty occurring.	Increase Warfighter Capability	Propulsion Upgrades_Sea	1319	04	0604029N	2011
								Total Navy	390,622

ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
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	13851
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	1906

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
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	2675
USMC	Advanced Technology Demo	Marine Corps Operational Energy: Energy Optimization and Logistic Burden Reduction	Advanced Technology Demonstration research to optimize energy usage and 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	5274
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	1950
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	549
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	272

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
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	111
USMC	Expeditionary Energy Office	Expeditionary Energy Concepts (E2C, formally ExFOB)	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	2036
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	174
USMC	MCWL/Futures Directorate	Hybrid Electric ITV Trailer (HEIT)	Combining proven technologies in a novel way, program seeks to provide an ITV-towable, V-22/CH-53/C130 transportable, Mobile Hybrid Power source that can use multiple fuel types to provide quiet sustained power	Increase Warfighter Capability	Contingency Basing	1319	03	0603640M	705
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	35
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	6930
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,	Enhance Mission Effectiveness	Contingency Basing	1109	06	0206315M	7670

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
			medical & messing facilities, environmental control equipment, & water purification systems.						
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	1324
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	330

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ORG	OE Program Title	OE Initiative Title	OE Project Description	OE Strategy Objectives	OE Activity Classification	Treasury Code	BA Code	Program Element	FY2021 (\$K)
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	69
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	319
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	189
USMC	Expeditionary Energy Office	Expeditionary Energy Office	A Director-level office within HQMC, E2O is responsible for advising the CMC and MROC on all energy and resource requirements, acquisitions, and programmatic decisions.	Increase Warfighter Capability	Individual/Warfighter Power	1106	04	0903798M	4130
								USMC Total	50,499

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