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OPERATIONAL ENERGY SUMMIT

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OPERATIONAL ENERGY IN ACTION

PART ONE



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OPERATIONAL ENERGY SUMMIT



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Sources:

1. Department of Defense 2016 Operational Energy Strategy,
2. Fiscal Year 2017 Operational Energy Budget Certification Report, May 2017

OVERVIEW OF OPERATIONAL ENERGY STRATEGY

Energy is a fundamental enabler of military capability. The ability of the United States to project and sustain the power necessary for defence depends on the assured delivery of this energy. It must be available at home and abroad, across air, land and sea, often through adverse weather and against determined adversaries.

As defined by law, operational energy is the “energy required for training, moving and sustaining military forces and weapons platforms for military operations”.¹ It includes²:

- The energy used by tactical power systems and generators;
- The energy used by weapons platforms themselves;
- Installation energy; the energy used to power installations and enduring locations.

In essence, operational energy is the energy used in military operations, in direct support of military operations, and in training that supports unit readiness for military operations.

The Operational Energy Strategy (2016) for the US Department of Defence (DoD) recognizes the crucial role of energy in enabling our forces to perform worldwide missions, while acknowledging energy as a potential vulnerability.

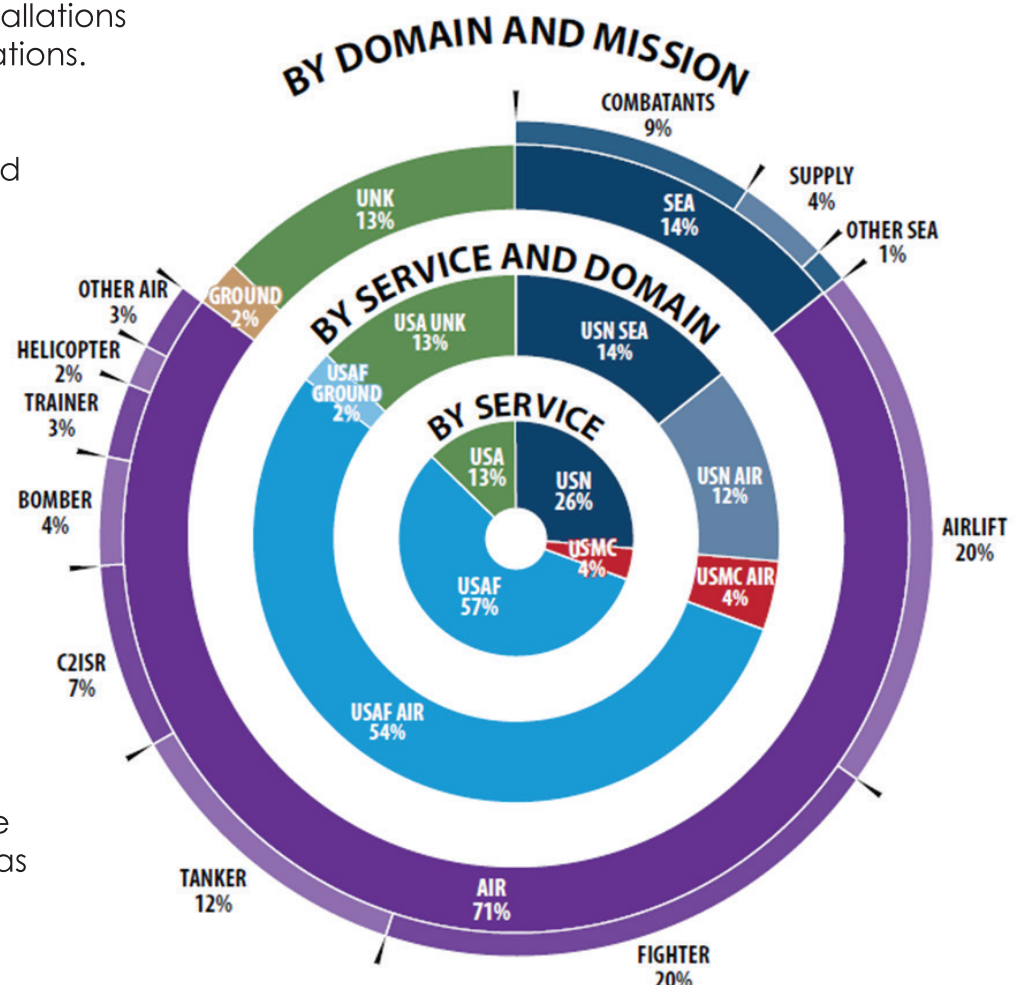


Figure 1 illustrates the Department's use of fuel to train, move, and sustain military forces and weapons platforms in FY 2014.

¹ 10 US Code § 2924

² The scope of operational energy excludes nuclear energy used for the propulsion of the U.S. Navy's aircraft carriers and submarines, as well as the energy used for military space launch and operations. – Source: 2016 Operational Energy Strategy

UPDATED STRATEGY

In (FY) 2014, the DoD consumed 87.4 million barrels of fuel across all enterprises to deploy and sustain worldwide missions. Moving forward, the department's weapons platforms and equipment are demanding more energy, albeit with increasing combat capability.

This energy use is dominated by air and sea platforms in the Air Force and Navy; the Air Force uses roughly half the fuel consumed by the DoD and the Navy consumes about one third.

Campaign analyses, wargames and decades of operational experience have demonstrated tradeoffs and risks that accompany the need for such large amounts of energy.

The previous (2011) Operational Energy Strategy began addressing these risks by:

- Reducing the demand for energy;
- Expanding and securing the supply of energy;
- Building energy security into the future force.

However, significant changes within the Department and operational environment now suggest a different approach is needed to address both new and enduring challenges.

CHANGES & CHALLENGES

While rising production of oil and gas within the United States and decreasing oil imports may bolster energy security and economic performance at home, the Department continues to operate at great distances.

For example, the Department's efforts to rebalance the Asia-Pacific region will further increase the demand for fuel⁴ as operations must be conducted across vast distances. Learning the lessons from logistical risks and vulnerabilities in Afghanistan, the Department needs to fully understand and mitigate a different set of risks posed by operating in the Pacific theater.

As well, next generation weapons platforms and concepts of operation often use more energy than their predecessors. As a result, the availability of operational energy remains an enduring challenge.

Finally, Anti-access/area-denial weapons like mines, ballistic and cruise missiles, advanced air defenses and improvised explosive devices (collectively, A2/AD) and hybrid threats pose escalating risks to the assured delivery of operational energy, and by extension, the ability to project and sustain power worldwide. While superior in terms of speed, survivability, stealth, payload, and maneuverability, next generation systems often require more energy. The ability of these new systems to meet their performance parameters frequently assumes an



assured supply of energy.

But, relative to the 2011 strategy, the Department now better understands the implications of energy use in its operations through improved analytical capacity. Specifically, the Department has gained substantial experience using Energy Supportability Analyses (ESAs) to inform the Energy Key Performance Parameter (eKPP) associated with specific military systems.

The initial strategy was not able to benefit from these technical, conceptual, and analytical improvements, and instead focused on energy demand and supply as well as congressionally mandated changes in the capability development process.

Improved fidelity in identifying logistical and operational risk now enables more precision in the prioritization of specific mitigations and responses.

The Department recognizes that while reducing the demand for energy is an essential component of any energy strategy, this may not always be an option. In response to these challenges, the 2016 Operational Energy Strategy takes advantage of improved technology and the Department's steadily improving understanding of operational energy challenges to ensure the consistent deliver of energy to the warfighter.

Specifically, the Department will pursue the following objectives:

1. Increase warfighter capability;
2. Identify and reduce risk;
3. Enhance current mission effectiveness



4 Quadrennial Defense Review (QDR) 2014

SUMMARY OF OBJECTIVES & GOALS

OBJECTIVE 1 - Increase Future Warfighting Capability

This objective focuses on increasing Warfighter capability through energy-informed force development. The Department will improve future combat effectiveness through integrating energy supportability into capability development and investing in innovation.

Summary of Goals:

- Institutionalize energy supportability analyses in capability development
- Improve combat effectiveness and supportability through innovation

OBJECTIVE 2 - Identify and Reduce Logistics and Operational Risks

Initiatives in this category seek to identify and mitigate warfighting gaps found in wargames, concepts of operation, and operation plans. The Department's focus on risk will ensure future forces are better aligned to mitigate potential threats to operations derived from energy.

Summary of Goals:

- Identify and mitigate energy related risks in deliberate planning
- Improve energy supportability of concepts of operation
- Diversify energy supplies to reduce risk

OBJECTIVE 3 - Enhance Mission Effectiveness of the Current Force

Initiatives in this objective may include material and non-material enhancements to day to day ops, upgrades, improvements, depot maintenance; changes in tactics, techniques, and procedures, and adaptations to professional military education (PME). Initiatives that fall in this category should field within one to two years, and do not include initiatives responding to specific operation plan risks or gaps.

Summary of Goals:

- Upgrade current equipment to improve energy use
- Improve energy behavior



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STRATEGIC GOALS BY DEPARTMENT

Following is a summary of how each Department plans to implement the 2016 Operational Energy Strategy, including overall budgets, key projects, and assessment rated, as determined by the ASD(EI&E).

ARMY

As a soldier-centric force, adaptations in soldier and leader behaviors are just as significant as changes in equipment. The Army is developing modeling and simulation tools that will improve the ability to make energy-informed decisions on force structure, acquisition, and OPLAN supportability. Additionally, the Army is focused on addressing the major consumers of operational energy with significant energy improvements to most of its mounted maneuver vehicles. A variety of improvements to logistics and fuel distribution systems will advance warfighting capability, while also reducing operational risks to the mission.

Budget Summary for operational energy initiatives:

- \$1.2 billion in (FY) 2017
- \$7.1 billion across the FYDP

Increase Future Warfighting Capability

Budget Breakdown:

- \$335.6 million in (FY) 2017
- \$2.3 billion across the FYDP

Key efforts include:

- Improved Turbine Engine Program (ITEP) (FY 2017 \$126.1 million; FYDP \$1,175.2 million)
- National Automotive Center (NAC) Dual Use Technologies (FY 2017 \$5.4 million; FYDP \$40.8 million)
- NAC Program – Power, Energy, and Mobility OIC (FY 2017 \$3.3 million; FYDP \$21.2 million)

Identify and Reduce Logistics and Operational Risks

Budget Breakdown:

- \$6.8 million in (FY) 2017
- \$69.0 million across the FYDP

Key efforts include:

- Early Entry Fluid Distribution System (E2FDS) (FY 2017 \$5.7 million; FYDP \$59.8 million)

Enhance Mission Effectiveness of the Current Force

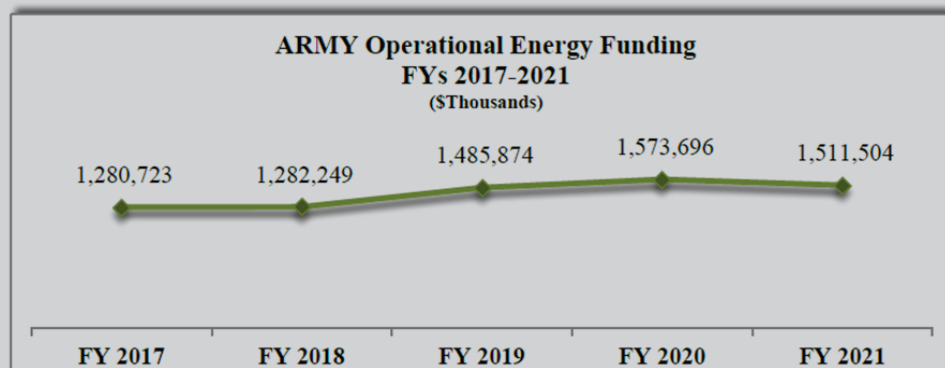
Budget Breakdown:

- \$938.1 million in (FY) 2017
- \$4.7 billion across the FYDP

Key efforts include:

- Improved Stryker (FY 2017 \$399.3 million; FYDP \$1,836.6 million)
- Improved Bradley (FY 2017 \$70.0 million; FYDP \$497.1 million)
- Joint Light Tactical Vehicle (JLTV) (FY 2017 \$107.8 million; FYDP \$732.5 million)
- Advanced Mobile Medium Power Sources (AMMPS) Generator Sets (FY 2017 \$92.3 million; FYDP \$406.8 million)
- Modular Fuel System (MFS) (FY 2017 \$12.8 million; FYDP \$60.3 million).
- Small Unit Power (SUP) Platoon Power Generation (FY 2017 \$2.2 million; FYDP \$25.5 million)
- Improved Abrams (FY 2017 \$3.9 million; FYDP \$19.4 million)

Figure 1. FYs 2017-2021 Army Total Operational Energy Funding



ARMY ASSESSMENT RATING:

GREEN

The ASD(EI&E) assessed the Army's budget proposal for (FY) 2017 as adequate for the implementation of the 2016 Operational Energy Strategy.

The Navy continues to promote the importance of operational energy through policy and specific investments in improved equipment. The Navy has established four working groups (Aviation, Expeditionary, Alternative Fuels and Maritime) focused on operational energy and dedicated a myriad of resources to implement Navy energy goals. Additionally, the Navy is integrating energy awareness into a comprehensive training and education plan. Across ships, aircraft, and other equipment, the Navy is investing in improved materials, energy storage, and improved propulsion.

Budget Summary for operational energy initiatives:

- \$459.4 million in (FY) 2017
- \$1.59 billion across the FYDP

Increase Future Warfighting Capability

Budget Breakdown:

- 292.0 million in (FY) 2017
- \$858.7 million across the FYDP

Key efforts include:

- Propulsion Task Force Energy (FY 2017 \$8.5 million; FYDP \$43.2 million)
- Advanced Power Generation (FY 2017 \$5.3 million; FYDP \$23.8 million)
- F-35 Engine Efficiency (FY 2017 \$8.1 million; FYDP \$8.1 million)

Identify and Reduce Logistics and Operational Risks

Budget Breakdown:

- \$16.9 million in (FY) 2017
- 83.6 million across the FYDP

Key efforts include:

- Alternative Fuels Test and Qualification Program (FY 2017 \$12.9 million; FYDP \$62.7 million)
- Environmental Control Unit 50 (ECU50/NETTP) (FY 2017 \$2.1 million; FYDP \$11.7 million)

Enhance Mission Effectiveness of the Current Force

Budget Breakdown:

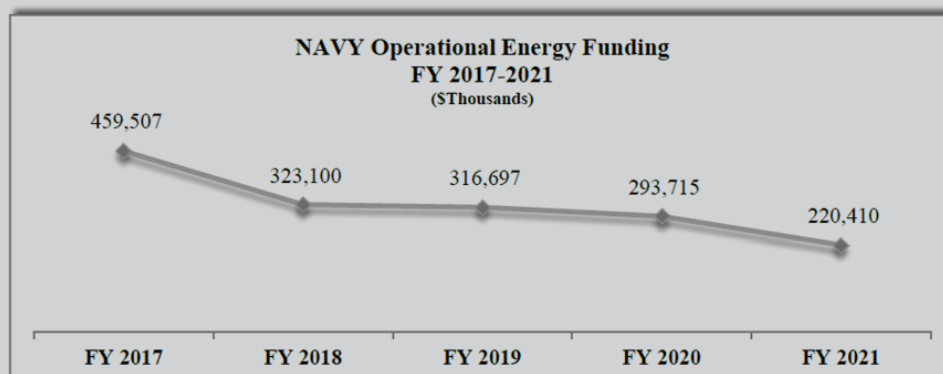
- \$150.5 million in (FY) 2017
- \$670.0 million across the FYDP

Key efforts include:

- Hybrid Electric Drive (HED) Implementation (FY2017 \$41.8 million; FYDP \$217.0 million)
- DDG 51 Solid State Lighting (SSL) (FY 2017 \$3.1 million; FYDP \$16.6 million)
- Heating Ventilation Air Conditioning & Refrigeration (HVAC&R) Efficiency Improvements (FY 2017 \$4.9 million; FYDP \$17.4 million)
- Military Sealift Command (MSC) Policy Guidance & Development and Training & Incentive Program (FY 2017 \$.6 million; FYDP \$2.5 million)



Figure 2. FY 2017-2021 Navy Total Operational Energy Funding



NAVY ASSESSMENT RATING:

GREEN

The ASD(EI&E) assessed the Navy's budget proposal for (FY) 2017 as adequate for the implementation of the 2016 Operational Energy Strategy.

MARINE CORPS

The demands of the future security environment are driving the Marine Corps to become a leaner force. To continue to meet its mission, the USMC is focusing near the forward line of troops, where the risks are the greatest. Operational energy investments support the fielding of energy efficient equipment to the Crisis Response Force and focus on extending the operational reach of the Marine Air Ground Task Force (MAGTF).

To further increase operational reach, Marines Corps research and development (R&D) is focused on innovative concepts such as energy harvesting using systems that produce electricity from stepping forces or back pack motion, energy storage using high performance battery technology and alternative energy sources in the form of mobile solar power via high efficiency, ultra-thin silicon solar cells.

Budget Summary for operational energy initiatives:

- \$39.0 million in (FY) 2017
- \$287.4 million across the FYDP

Increase Future Warfighting Capability

Budget Breakdown:

- \$15.5 million in (FY) 2017
- \$89.7 million across the FYDP

Key efforts include:

- Expeditionary Energy Office (E2O) (FY 2017 \$3.5 million; FYDP \$17.6 million)
- Expeditionary Energy Concepts (E2C; formerly Experimental Forward Operating Base)
- Improved Environmental Control Units (ECUs) (FY 2017 \$.3 million; FYDP \$2.4 million)

Identify and Reduce Logistics and Operational Risks

Budget Breakdown:

- Although USMC will not invest directly in initiatives that support this strategic objective, the Service will benefit from investments made by Navy.

Enhance Mission Effectiveness of the Current Force

Budget Breakdown:

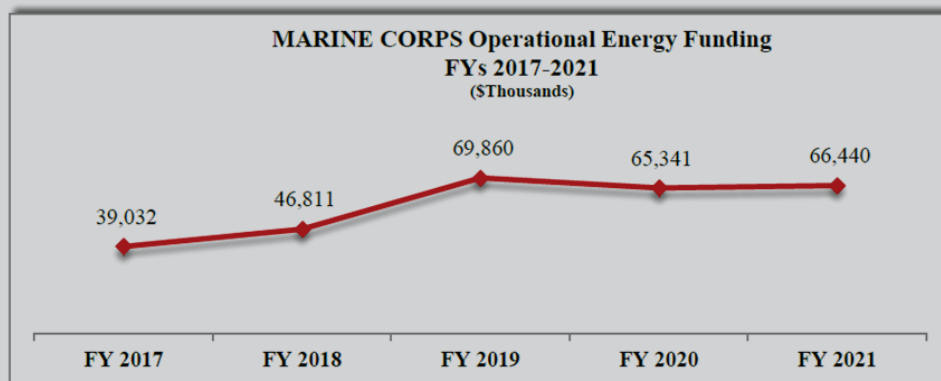
- \$23.5 million in (FY) 2017
- \$197.7 million across the FYDP

Key efforts include:

- Advanced Power Sources - Ground Renewable Expeditionary Energy Network System (GREENS)/ Mobile Electric Hybrid Power Sources (MEHPS)/ Radio Power Adapters (FY 2017 \$14.6 million; FYDP \$67.5 million)
- Fuel Efficient Medium Tactical Vehicle Replacement (FE MTVR) Future Naval Capability (FNC) Transition (FY 2017 \$5.3 million; FYDP \$33.0 million)
- Improved Environmental Control Units (FY 2017 \$.8 million; FYDP \$13.1 million)



Figure 3. FY 2017-2021 Marine Corps Total Operational Energy Funding



MARINE CORPS ASSESSMENT RATING:

GREEN

The ASD(EI&E) assessed the Marine Corps budget proposal for (FY) 2017 as adequate for the implementation of the 2016 Operational Energy Strategy.

AIR FORCE

As the largest consumer of operational energy in the Department, the U.S. Air Force (USAF) is investing in a range of material and non-material initiatives to address the use of energy in aircraft. These range from new propulsion technologies, aircraft design, composite materials and structures, to operational tools designed for improved flight performance.

Over the long-term, new propulsion, power, and thermal management systems may dramatically improve the range and endurance of combat aircraft. More immediately, the Air Force is upgrading engines on the KC-135 tanker and funding a range of improvements to the airlift and tanker fleet.

Budget Summary for operational energy initiatives:

- \$626.0 million in (FY) 2017
- \$4.1 billion across the FYDP

Increase Future Warfighting Capability

Budget Breakdown:

- \$504.2 million in (FY) 2017
- \$3.5 billion across the FYDP

Key efforts include:

- Adaptive Engine Technology Development (AETD) and Adaptive Engine Transition Program (AETP) (FY 2017 \$287.8 million; FYDP \$2,429.5 million)
- Air Dominance Adaptive Propulsion Technology (ADAPT) (FY 2017 \$26.9 million; FYDP \$195.6 million)
- Integrated Vehicle Energy Tech (INVENT) Spiral III (FY 2017 \$3.4 million; FYDP \$33.0 million)

Identify and Reduce Logistics and Operational Risks

Budget Breakdown:

- \$6.7 million in (FY) 2017
- \$35.3 million across the FYDP

Key efforts include:

- Fuel Assessment and Evaluation (FY 2017 \$6.7 million; FYDP \$35.3 million)

Enhance Mission Effectiveness of the Current Force

Budget Breakdown:

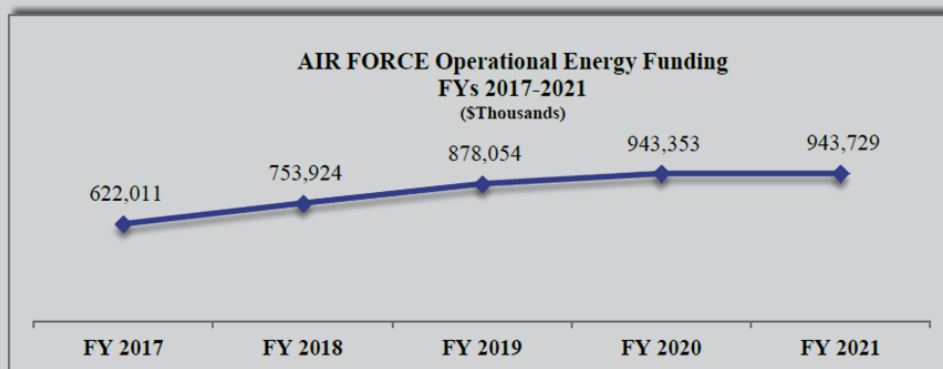
- \$111.0 million in (FY) 2017
- \$542.8 million across the FYDP

Key efforts include:

- KC-135 Engine Upgrades (FY 2017 \$106.0 million; FYDP \$530.0 million)
- Mission Indexed Flying (MIF) (FY 2017 \$0.035 million; FYDP \$0.183 million)
- Legacy Fleet Energy Efficiency (FY 2017 \$3.2 million; FYDP \$9.5 million)
- Surfing Aircraft Vortices for Energy (\$AVE) Formation Flight Advanced (FY 2017 \$1.5 million; FYDP \$2.5 million)



Figure 4. FY 2017-2021 Air Force Total Operational Energy Funding



AIR FORCE ASSESSMENT RATING:

GREEN

The ASD(EI&E) assessed the Air Force's budget proposal for (FY) 2017 as adequate for the implementation of the 2016 Operational Energy Strategy.

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE FOR ENERGY (OSAD)

In FY 2014, six new OECIF programs focused on analytical methods for incorporating operational energy considerations into Department planning and decision making. In FY 2015, OECIF began a shift away from contingency bases and toward mobile platforms that consume much of the Department's fuel. The main FY 2015 initiative significantly expands on-going collaboration with DoE under the Advanced Vehicle Power Technology Alliance with a focus on improving the energy performance and range of DoD's current tactical ground vehicles.

The FY 2016 call for proposals was released in September 2015. Proposals were received in January 2016 and awards were made in March 2016. The FY 2016 program has continued the shift within OECIF toward energy use in mobile platforms, and focus on improving the operational energy performance of unmanned aerial, surface, undersea, and ground vehicles useful in the Asia-Pacific. The program has sought to improve the energy related military capabilities or performance of unmanned vehicles for the Pacific and/or reduce the burdens and risks from our energy supply line.

Budget Summary for operational energy initiatives:

- \$47.7 million in (FY) 2017
- \$248.9 million across the FYDP

- Improving Fuel Economy for the Current Ground Tactical Fleet Program (FY 2015 start) (FY 2017 \$7.3 million; FYDP \$14.1 million)

Increase Future Warfighting Capability

Budget Breakdown:

- \$40.3 million in (FY) 2017
- \$219.5 million across the FYDP

Key efforts include:

- Operation of the Office of the Deputy Assistant Secretary of Defense for Operational Energy (ODASD(OE)) (FY 2017 \$5.1 million; FYDP \$25.7 million)
- Synthetic Theater Operations Research Model – Enhanced Expeditionary Energy (STORM-E) (FY 2014 start) (FY 2017 \$1.2 million; FYDP \$1.2 million)
- Operational Energy Analysis Task Force (OEATF) (FY 2014 start) (FY 2017 \$1.7 million; FYDP \$1.7 million)
- Energy Integration and Interoperability (FY 2014 start) (FY 2017 \$.7 million; FYDP \$.7 million)
- Capability Assessment and Modeling for Energy Logistics (CAMEL) (FY 2014 start) (FY 2017 \$1.3 million; FYDP \$1.3 million)

Identify and Reduce Logistics and Operational Risks

Budget Breakdown:

- The OASD(EI&E) did not budget resources specifically aligned to identify and reduce logistics and operational risks to mission. However, O&M funding for the ODASD(OE) provides the capacity to oversee these and other elements of the 2016 Operational Energy Strategy, support and contribute to studies, models, and simulations of operational energy risk, as well as participate in Service Title 10 wargames.

Enhance Mission Effectiveness of the Current Force

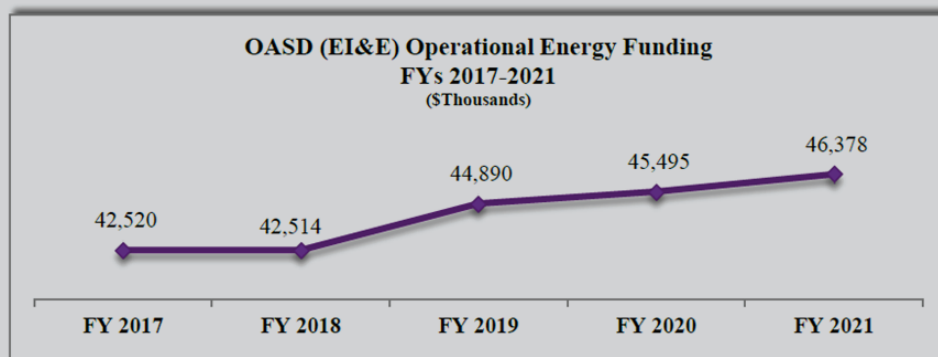
Budget Breakdown:

- \$2.2 million in (FY) 2017
- \$2.2 million across the FYDP

Key efforts include:

- Joint Deployment Energy Planning and Logistics Optimization Initiative (J-DEPLOI) (FY 2014 start) (FY 2017 \$2.2 million; FYDP \$2.2 million)

Figure 5. FYs 2017-2021 OASD(EI&E) Total Operational Energy Funding



DEFENSE LOGISTICS AGENCY

As the largest consumer of operational energy in the Department, the U.S. Air Force (USAF) is investing in a range of material and non-material initiatives to address the use of energy in aircraft. These range from new propulsion technologies, aircraft design, composite materials and structures, to operational tools designed for improved flight performance.

Over the long-term, new propulsion, power, and thermal management systems may dramatically improve the range and endurance of combat aircraft. More immediately, the Air Force is upgrading engines on the KC-135 tanker and funding a range of improvements to the airlift and tanker fleet.

Increase Future Warfighting Capability

Budget Breakdown:

- DLA initiatives do not align to long-term improvements for increase future warfighting capability.

Identify and Reduce Logistics and Operational Risks

Budget Breakdown:

- \$1.1 million in (FY) 2017
- \$21.0 million across the FYDP

Key efforts include:

- Energy Efficiency and Alternate Energy Technologies (FY 2017 \$1.1 million; FYDP \$6.0 million)

Enhance Mission Effectiveness of the Current Force

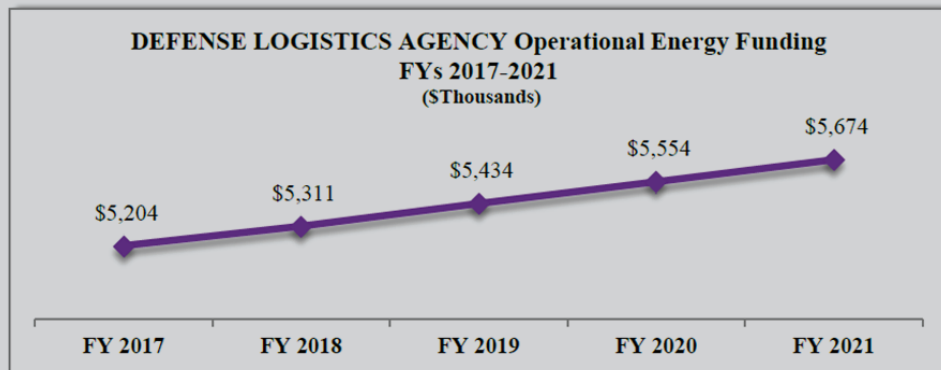
Budget Breakdown:

- \$4.0 million in (FY) 2017
- \$2.2 million across the FYDP

Key efforts include:

- Battery Network (FY 2017 \$4.0 million; FYDP \$21.0 million)

Figure 6. FYs 2017-2021 DLA Total Operational Energy



OSD AND DLA ASSESSMENT RATING:

GREEN

The ASD(EI&E) assessed the OASD(EI&E's) budget proposals for (FY) 2017 as adequate for the implementation of the 2016 Operational Energy Strategy.

CONCLUSION

Strategic Summary

Since the previous Operational Energy Strategy document (2011), the Department has progressed in refining their use of energy at contingency bases, adapted their requirements and force development process, and established operational energy policy and oversight across the Services, Combatant Commands, and the Department overall.

The 2016 Operational Energy Strategy reflects the essential role of operational energy in warfighting, as well as the liabilities of that dependence through the threats to its assured delivery. Implementing this strategy will include a comprehensive set of initiatives to improve future capability, reduce risk, and enhance current mission effectiveness.

This approach will lighten the logistics footprint, ensure uninterrupted operations in contested environments (with a focus on the Asia-Pacific region, in particular), and better inform Department decision-making across planning,

programming, requirements, acquisition, budgeting, execution, and operational planning.

Budgetary Summary

The OASD(EI&E) has certified that the (FY) 2017 Budget as sufficient for implementing the 2016 Operational Energy Strategy.

The Department is making the necessary investments to ensure the delivery of operational energy to forces deployed and operating worldwide across objectives dedicated to improving long-term capability, identifying and decreasing operational risk, and enhancing mission effectiveness of the current force.

While there are areas of concern, the Department is making progress toward achieving a more capable and supportable force. Rather than a single program or approach, the Department is using a comprehensive set of initiatives to address operational energy concerns through materiel and non-materiel changes across current operations, mid-term plans, and long-term capability development.