

Fiscal Year 2012 Operational Energy Budget Certification Report



January 2011

**Assistant Secretary of Defense for
Operational Energy Plans and Programs**

Preparation of this study/report cost the Department of Defense a total of approximately \$191,151 for the 2011 Fiscal Year.

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Fiscal Year 2012 Operational Energy Budget Certification Report Errata

The errata list below shows the revisions to the FY12 Operational Energy Budget Certification Report to Congress. The funding on the following pages should be adjusted as shown below:

Executive Summary

- Page 5: Change \$431M in FY2012 to \$368M in FY2012
- Page 5: Change \$2.2B across the FYDP to \$2.0B across the FYDP

Department of Navy

- Page 14: Change \$431M in FY2012 to \$368M in FY2012
- Page 14: Change \$2.2B across the FYDP to \$2.0B across the FYDP

United States Navy

- Page 14: Change \$389M in FY2012 to \$345M in FY2012
- Page 14: Change \$2.0B across the FYDP to \$1.7B across the FYDP

United States Marine Corps

- Page 18: Change \$42M in FY 2012 to \$23M in FY 2012
- Page 18: Change \$322M across the FYDP to \$304M across the FYDP
- Page 20: Change \$4.6M in FY2012 O&M to \$5M in FY2012
- Page 20: Change \$28M across the FYDP to \$29M across the FYDP
- Page 20: Change \$30M in FY2012 Procurement to \$14M in FY2012
- Page 20: Change \$244.8M across the FYDP to \$233M across the FYDP
- Page 21: Change \$7.0M in FY2012 RDT&E to \$4M in FY2012
- Page 21: Change \$49.2M across the FYDP to \$42M across the FYDP



ASSISTANT SECRETARY OF DEFENSE

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OPERATIONAL ENERGY
PLANS AND PROGRAMS

JAN 31 2011

MEMORANDUM FOR THE SECRETARY OF DEFENSE

SUBJECT: Fiscal Year 2012 Operational Energy Budget Certification Report

The energy required to conduct military operations, or "operational energy," is essential to the Department of Defense's core mission to protect the security of the nation. In current operations, for example, deployed forces and fixed installations that directly support military operations require a steady supply of energy for mission success. In an increasingly complex and dynamic security environment, future U.S. forces will also require a reliable supply of operational energy in order to be able to rapidly respond to a range of contingencies around the world.

The security of operational energy supplies, however, is by no means assured. Today, historically high and growing operational energy demands are having an impact on military effectiveness, raising the risks and costs for U.S. forces. On the battlefield, large fuel supply lines are challenging to route, vulnerable to attack, and consume significant combat and monetary resources. At home, installations supporting military operations draw significant amounts of power from the civilian electricity grid, which is vulnerable to a range of disruptions. In the longer term, growing global demand for oil and the concentration of supplies will mean continued price volatility, potential supply disruptions, and geostrategic consequences.

Maintaining an operationally effective military force with the capability and capacity to respond across the spectrum of 21st century security challenges requires that the Department of Defense improve its operational energy security. The Department must take steps to reduce operational energy demand, increase the use of alternative energy sources, and institutionalize operational energy considerations throughout the Department of Defense. Doing so will benefit military readiness and also translate to important efficiency gains. In that respect, many of the operational energy initiatives profiled in this report are consistent with your direction to the Services to increase efficiency.

To this end, the Fiscal Year (FY) 2009 National Defense Authorization Act directed the appointment of a Director of Operational Energy Plans and Programs in the Department of Defense with the responsibilities of establishing a Department-wide strategy for operational energy and coordinating and overseeing planning and program activities of the DoD Components related to: implementation of the operational energy strategy; the consideration of operational energy demands in defense planning, requirements, and acquisition processes; research and development investments related to operational energy demand and supply technologies; and monitoring and reviewing all operational energy initiatives in the Department of Defense. As part of these responsibilities, the Director must review the DoD Components' proposed budgets and not later than January 31 of the preceding fiscal year for which the budgets are proposed, provide the Secretary of Defense a report containing the Director's analysis, comments, and findings of operational energy aspects of the proposed budgets as well as the certification of the Director regarding whether the proposed budget is adequate for implementation of the operational energy strategy. The FY 2011 National Defense

Authorization Act changed the Director of Operational Energy Plans and Programs to the Assistant Secretary of Defense for Operational Energy Plans and Programs. This report satisfies that requirement for the proposed FY 2012 budgets.

This initial Operational Energy Budget Certification Report was uniquely challenging. Since the FY 2012 budget reflects activities conducted throughout 2010, the inaugural Operational Energy Strategy was not able to influence the development of the DoD components' proposed budgets. As a result, I chose to evaluate the DoD Components' proposed budgets against their own energy strategies and goals. Subsequent certification reviews will have the Department of Defense's Operational Energy Strategy as its baseline. In addition, the office of Operational Energy Plans and Programs (OEPP) was created in late July of 2010; staff is still being hired. Subsequent budget certifications will benefit from more rigorous analysis. Nevertheless, this initial certification process was instructional both for the DoD Components and for the Operational Energy Plans and Programs staff by identifying or establishing processes to track operational energy investments and creating new data calls to collect information relevant to operational energy usage.

As the Assistant Secretary of Defense for Operational Energy Plans and Programs, I certify that the proposed budgets are adequate for the implementation of the operational energy aspects of the DoD Components' energy strategies and goals.



Sharon E. Burke

Attachment:
Fiscal Year 2012 Operational Energy Budget Certification Report

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EXECUTIVE SUMMARY

This is the inaugural Operational Energy Budget Certification. It is unique and subsequent certification will differ. The uniqueness of this certification is a result of the Department of Defense's *Operational Energy Strategy* not being available to influence the development of the Components' proposed FY 2012 budgets. I chose to evaluate the military departments' proposed budgets against their own operational energy strategies and goals to address this issue. Despite this limitation the budget certification process provided valuable insights into each of the DoD Components' operational energy planning and program activities.

The Department of the Army budgeted \$212M in FY 2012 and approximately \$1.1B across the FYDP for operational energy initiatives. Approximately 81% of this funding is for Science and Technology efforts. It has implemented efforts to immediately reduce operational energy demand in theater through programs such as the Advanced Mobile Medium Power Sources (AMMPS), which will improve the efficiency of generators in the field and reduce the amount of fuel needed to power them. In its efforts to "Increase Energy Efficiency Across Platforms and Facilities", it has made Science and Technology investments for ground vehicle power and mobility integration, and rotorcraft propulsion and drives. In its efforts to "Increase Use of Renewable/Alternative Energy", it has funded alternative energy technologies, hybrid intelligent power, and efforts for the dismounted soldier. To strengthen its operational energy efforts, the Department of the Army should budget for the \$1.4M per year sustainment costs of the Tactical Fuel Managers Defense (TFMD) system to improve monitoring and measuring efforts, and identify and budget for energy efficiency improvements to legacy platforms to meet its "Energy Security Goal" of "Increase Energy Efficiency Across Platforms."

The Department of the Navy budgeted \$431M in FY 2012 and approximately \$2.2B across the FYDP for operational energy initiatives. Approximately 31% of this funding is for Science and Technology efforts. The Navy has implemented and resourced efforts, such as the i-ENCON program, to immediately reduce operational energy intensity. To "Increase Alternatives Afloat", it has funded alternative fuels research, and Hybrid Electric Drive Research and Development for the DDG 51 Class ships along with entering into an MOU with the Department of Agriculture. It has funded the procurement of operational-scale volumes of fuel for the "Great Green Fleet." It has budgeted for expenditures and investment to "Increase Efficiency Afloat." These efforts include monitoring and measuring, science and technology, procurement and operation maintenance funding for legacy vessel upgrades. The Department of the Navy also has budgeted for USMC expeditionary energy efficiency efforts for current and future forces. The Department of the Navy has sufficiently funded its operational energy initiatives.

Report on Operational Energy Budget Certification for Fiscal Year 2012

The Department of the Air Force budgeted \$261M in FY 2012 and approximately \$922M across the FYDP for operational energy initiatives. All of this funding is for Science and Technology efforts. The Service has implemented efforts to immediately reduce operational energy demand through procedural changes in the operations of large airlift aircraft. It also makes investment in research and development efforts to enable energy efficiencies in legacy and future systems. It has budgeted for the certification of aircraft, vehicles, and fuel delivery systems to use alternative fuel blends. To strengthen its operational energy efforts in the upcoming budgets, I recommend the Department of the Air Force budget for the development and improvement of data collection and analysis programs to improve monitoring and measuring efforts, identify and budget additional resources for energy efficiency improvements to legacy systems, and to improve their operational modeling and simulation tools at the campaign level to incorporate operational considerations.

After careful consideration, I have certified each DoD Component's proposed budget is adequate for implementation of the operational energy aspects of their energy strategy. Nevertheless, I have the following concerns:

- Across the Department of Defense, we generally do not have a clear understanding of how energy is being consumed at the point of use and therefore, are unable to make well informed resourcing decisions.
- Energy efficiency upgrades to the legacy ground and air fleets have not been identified or adequately funded by all the Services but significant opportunities exist to economically build a more energy efficient force through these upgrades.
- Approximately 58% of the Department's funding for operational energy efforts is budgeted for Science and Technology efforts. Additional funds should be budgeted within the FYDP for the planned deployment of maturing operational energy technologies and systems.
- Energy costs are underestimated in analyses used to inform investment decisions across the Department in that assets and infrastructure used to move and deliver fuel are not included.
- Operational energy concerns are not adequately addressed in force development modeling and simulation resulting in less than optimal and sometimes inadequately informed recommendations and tradeoffs.

I expect my next budget certification to be significantly different. The Department-wide *Operational Energy Strategy* will be released in early 2011, and will shape the development of

Report on Operational Energy Budget Certification for Fiscal Year 2012

proposed FY 2013 budgets. This will enable the Component's to budget for and be evaluated against DoD-wide operational energy objectives and targets.

APPROACH TO BUDGET CERTIFICATION

For this FY 2012 budget certification assessment, I chose to evaluate the military departments' proposed budgets against their own energy strategies and goals. The energy strategies and goals were provided by the Components. We spent substantial time developing an understanding of the DoD Components' energy strategies and goals, their underlying assumptions and analyses, and how they related to improving the effectiveness of the total force. As a part of this effort, we identified the operational energy relevant goals or targets inherent in the DoD Components' energy strategies and goals. These operational energy relevant goals or targets became the criteria for the certification of the DoD Components' proposed budgets.

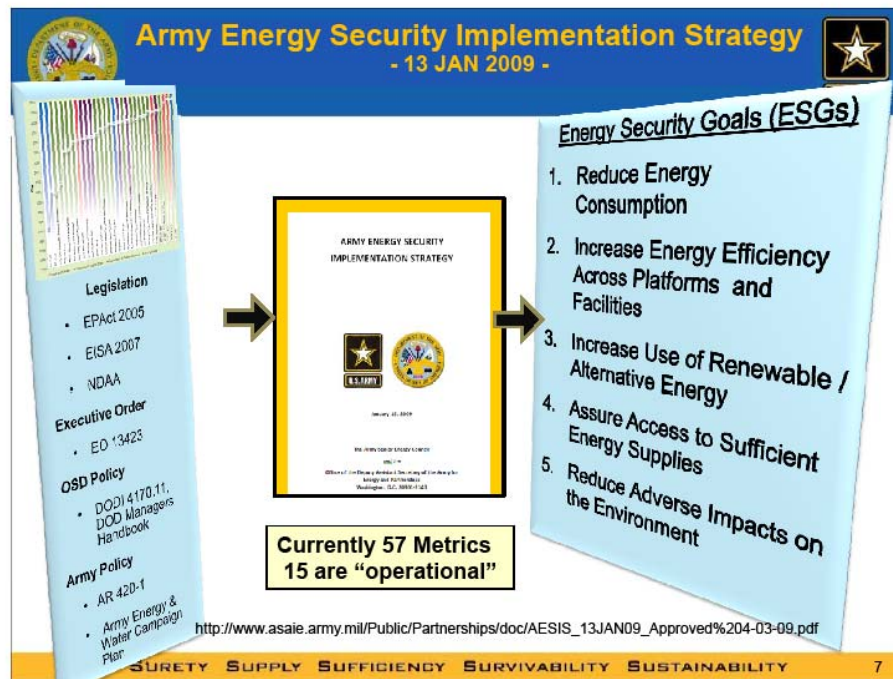
We then collected the operational energy funding details at the Program Element level and below for the proposed FY 2012 budget of each military department, reviewed the relevant budget justification documentation, and asked for additional information as required. Finally we made an assessment of the adequacy of each department's proposed budget for its operational energy relevant goals or targets.

Throughout this process, the Operational Energy Plans and Programs staff worked with staff points of contact in the military departments to gain information, a deeper understanding of the information, and to resolve issues.

For this first Operational Energy Budget Certification, I used a stoplight rating chart. A goal or target I judged to be adequately funded I rated as "green;" a goal or target I judged to be partially funded rated "yellow;" goals or targets that were not funded were rated "red." Higher level goals or targets composed of two or more subordinate goals or targets were scored as a composite of the subordinate goals. For next year's certification report, I plan to develop a quantitative rating scale.

Department of the Army Operational Energy Budget Certification

The Department of the Army funds and manages the vast majority of ground force operational energy capability development efforts to include many technologies shared with the Marine Corps. To this end, the Army budgeted \$212M in FY 2012 and approximately \$1.1B across the FYDP for operational energy initiatives. Approximately 81% of this funding is for Science and Technology efforts. We measured the Army’s FY 2012 budget submission against its 2009 Army Energy Security Implementation Strategy. However, the Department of the Army also provided the draft U.S. Army Power and Energy Strategy White Paper, dated April 1, 2010, which provides a framework to guide development of power and energy capabilities which support Army requirements in the near, mid, and long-term. Although we felt the white paper is an excellent resource, its goals do not appear to be reflected in the Army’s budget submission. The Department of the Army’s Energy Security Implementation Strategy is built around the five Energy Security Goals (ESGs) shown below:



The Department of the Army’s Energy Security Goals applicable to FY 2012 Operational Energy Budget Certification include: “Reduce Energy Consumption,” “Increase Energy Efficiency Across Platforms and Facilities,” and “Increase Use of Renewable/Alternative Energy Supplies.”

Report on Operational Energy Budget Certification for Fiscal Year 2012

The Department of the Army's Energy Security Goal of "Reduce Energy Consumption" focuses on reducing the amounts of power and fuel consumed by the Army at home and in theater. This goal assists in minimizing the logistical fuel tail in tactical situations by improving fuel inventory management and focusing installation consumption on critical functions. The Army has taken steps to identify and reduce energy consumption to include those for operational requirements. These steps include establishing the Army's Senior Energy Council, publishing the Army Energy Security Implementation Strategy in 2009, and publishing a U.S. Army Power and Energy White Paper in 2010 that provides detail on operational energy challenges and potential solutions. Additionally Army Major Commands such as Forces Command have sought no- and low-cost initiatives to reduce energy consumption.

To address requirements within theater, the Army has focused on reducing the amount of fuel required in base camps. Department of the Army efforts such as tent foaming, Advanced Mobile Medium Power Sources (AMMPS), and Smart and Green Energy (SAGE) are focused on reducing fuel requirements in base camps. The Army did not provide budget data on tent foaming and it is unclear if this effort will continue in the FY 2012 timeframe. The Army budgeted for both AMMPS RDT&E and procurement in the FY 2012 budget. AMMPS is a replacement for the currently fielded Tactical Quiet Generators. The AMMPS generators take advantage of current technology to provide power generation capabilities that are easier to operate, easier to repair, are more fuel efficient and reduce overall costs. SAGE comprises a number of commercial off-the-shelf technologies (e.g., intelligent power systems, energy storage, energy-efficient structures and renewable sources). Although it should reduce fuel consumption by 30-60 percent where applied and is scheduled for a FY 2011 demonstration, SAGE is not funded within the FY 2012 budget.

The Department of the Army's Energy Security Goal of "Increase Energy Efficiency Across Platforms and Facilities" focuses on increasing the energy efficiency for generation, distribution, storage and end-use of electricity and fuel for system platforms, facilities, units and individual soldiers and civilians. This goal also relates to the productivity of a system based on energy requirements and supports the ability to make informed trade-offs in development, engineering and deployment of weapon systems. Energy consumption data is required to make informed trade-offs and the Army will make a step forward with the deployment of the Tactical Fuel Managers Defense (TFMD) system to theater in FY 2011. TFMD is an Army enterprise system capable of tracking fuel requirements, inventory and consumption to the retail level and it will provide a significant amount of quality data upon which to base future resourcing decisions. Unfortunately the TFMD FY 2012 sustainment costs of \$1.4M are not funded in Army's FY 2012 budget.

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To support the Energy Security Goal of “Increase Energy Efficiency Across Platforms” the Department of the Army makes science and technology investments in ground and aerial vehicle efforts in the FY 2012 budget. The Army invests \$51M in FY 2012 and \$332M through the FYDP for Ground Vehicle Power and Mobility Integration to mature and demonstrate power and thermal management technologies in an integrated environment. Significant efforts include:

- Integrated high-efficient intelligent power and thermal components through intelligent controls
- Reconfigurable integration test bed to demonstrate power, energy and mobility system components in a relevant environment
- Ability to test advanced electronic components in a simulated vehicle environment
- Pulse power supply and advanced energy storage devices for electrified armor
- Durable, fire and blast resistant high performance lightweight track

Army invests \$19M in FY 2012 and \$114M through the FYDP for Rotorcraft Propulsion and Drives to develop and demonstrate high performance, fuel efficient gas turbine engines and light-weight, highly reliable drive systems that improve range and payload, with reduced logistics burden. Significant efforts include:

- Mature 3000 shaft horsepower engine and drive system demonstrators ready for transition to EMD program for UH-60/AH64 application
- Lightweight, high-temperature materials/coatings for internal engine components
- Advanced gears allowing increased torque
- Composite housings and shafts for weight savings

Increasing the energy efficiency of the legacy ground and air platforms presents the greatest opportunity for reducing operational energy requirements. The science and technology efforts discussed above could provide energy efficiencies that transition to the legacy platforms. The Department of the Army has not budgeted for the near-term and mid-term modifications to legacy systems in order to reduce operational energy demand in the proposed FY 2012 budget.

The Department of the Army’s Energy Security Goal of “Increase Use of Renewable/Alternative Energy” focuses on increasing the share of renewable/alternative

resources for power and fuel use, which can provide a decreased dependence upon conventional fuel sources. This goal also supports national goals related to renewable/alternative energy. The Department of the Army's FY 2012 budget provides FY 2012 funding of \$13M and FYDP funding of \$68M for Alternative Energy Technologies. Efforts in this area provide:

- Tactical ground systems evaluation data using renewable and synthetic fuels for system performance and possible approval and acceptance of alternative fuels for wide-spread use
- Capability for vehicles to transfer power to/from the power grid
- Hybrid electric vehicle energy storage system that utilizes renewable energy to provide energy to forward operating bases

The Department of the Army also invests \$5M in FY 2012 and \$25M across the FYDP for Hybrid Intelligent Power to demonstrate promising technologies that use wind, solar, intelligent generators, and batteries to increase efficiency to reduce fuel use on the battlefield. Efforts in this area provide wind turbines, solar cell panels, absorbed glass material batteries, and auto on/off diesel generators which are easily transportable and configurable.

Finally, the Department of the Army is investing in efforts to provide power for the dismounted soldier. The Army's FY 2012 budget provides FY 2012 funding of \$20M and FYDP funding of \$113M to investigate and develop advanced power sources, power components, and power conversion technology for the Future Force dismounted soldier that enhance sustainability and mobility through use of lighter, high energy, fuel efficient hybrid power systems, and energy management techniques. Efforts in this area provide:

- High energy density power sources
- Advanced power sources for increased lethality and survivability
- Network-centric power management tools to determine energy status, availability, and location of power and energy resources on battlefield
- Increased sustainability, mobility, and reduced maintenance
- Reduced power component weight and volume

The Assistant Secretary of Defense for Operational Energy Plans and Programs assessment of the adequacy of the funding for operational energy requirements in the Department of the

Army’s proposed FY 2012 budget to the Energy Security Goals is shown below:

Department of the Army	
Operational Energy ESG's	Rating
Reduce Energy Consumption	Yellow
- Current/Near-term Efforts	Yellow
- In Theater Efforts	Yellow
Increase Energy Efficiency Across Platforms and Facilities	Yellow
- Monitoring & Measuring Efforts	Red
- S&T Efforts	Green
- Legacy Platform Efforts	Red
Increase Use of Renewable/Alternative Energy Supplies	Green

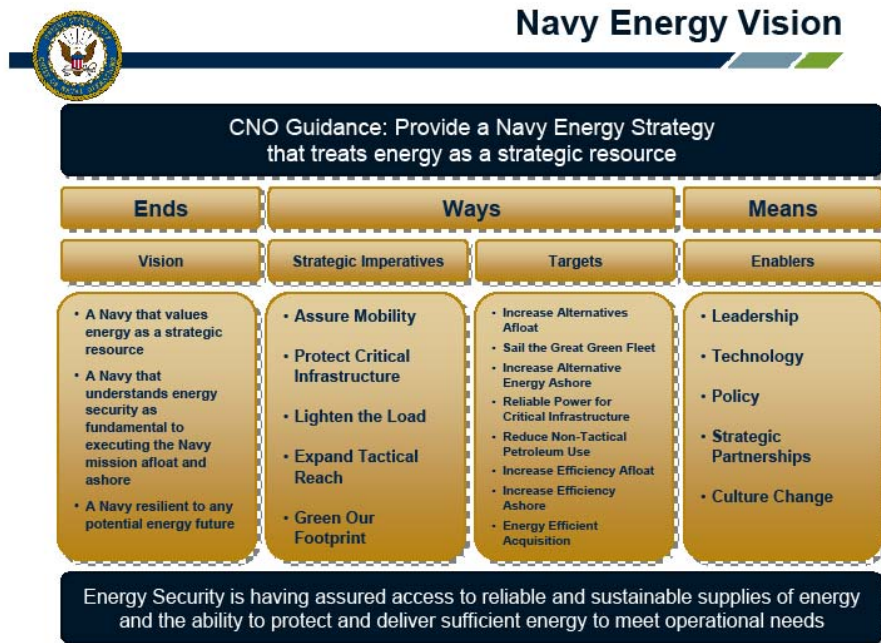
The Department of the Army seeks to apply the “Reduce Energy Consumption” Energy Security Goal within the theater of operations in order to reduce the logistical fuel tail in tactical situations. Additionally, the Army makes investments to “Increase Energy Efficiency Across Platforms and Facilities,” and to “Increase Use of Renewable/Alternative Energy Supplies.” To strengthen its operational energy efforts, the Department of the Army should demonstrate greater current and near-term operational energy savings, budget for a smart micro-grid such as SAGE to reduce energy consumption in theater, budget for the \$1.4M per year sustainment costs of the Tactical Fuel Managers Defense (TFMD) system to improve monitoring and measuring efforts, and identify and budget for energy efficiency improvements to legacy platforms. The Assistant Secretary of Defense for Operational Energy Plans and Programs, certifies the Army FY 2012 budget meets its Energy Security Implementation Strategy. The Department of the Army FY 2013 budget will be certified against the Department of Defense’s *Operational Energy Strategy*. This may require additional operational energy efforts to be budgeted for in the FY 2013 budget in order to achieve a certified budget.

Department of the Navy Operational Energy Budget Certification

The Department of the Navy (DON) has published an energy strategy that guides both Navy and United States Marine Corps investment. This overarching strategy lays out the Secretary of the Navy goals to: Increase the use of alternatives afloat and ashore, reduce non-tactical vehicle petroleum use, and promote energy efficient acquisition. The Department of the Navy budgeted \$431M in FY 2012 and approximately \$2.2B across the FYDP for operational energy initiatives. Approximately 31% of this funding is for Science and Technology efforts. Navy and Marine Corps funding is addressed separately in the below discussion.

US Navy Operational Energy Program

The Navy budgeted \$389M in FY 2012 and approximately \$2.0B across the FYDP for operational energy initiatives. Approximately 35% of this funding is for Science and Technology efforts. The Navy’s energy strategy supports the DON strategy and is centered on energy security, energy efficiency and environmental stewardship while remaining the preeminent maritime power. The Navy’s Ends, Ways, and Means to accomplish the strategy are shown below:



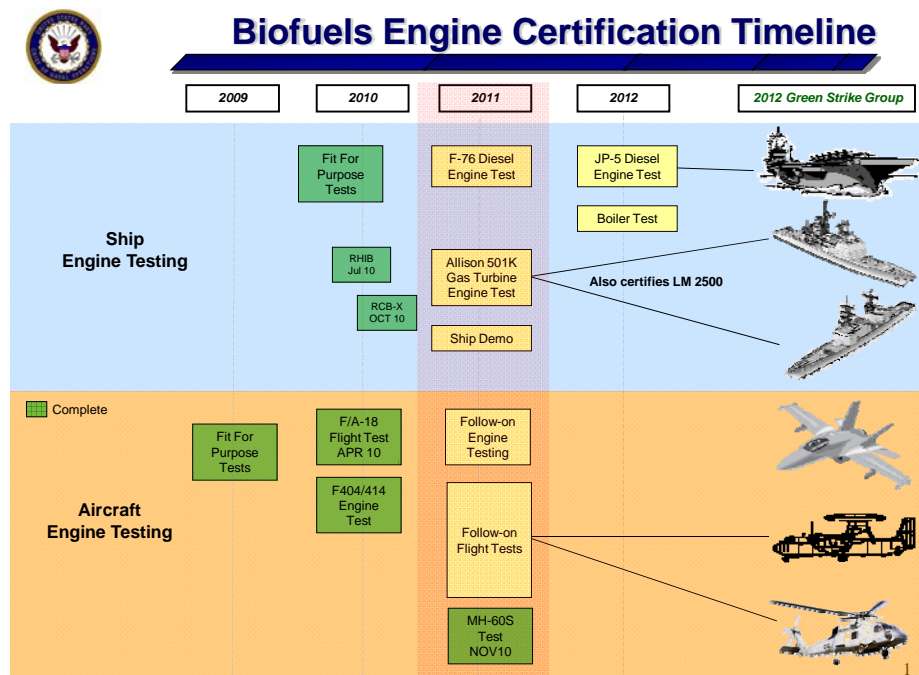
The targets applicable to FY 2012 Operational Energy Budget Certification include: “Increase Alternatives Afloat”; “Sail the Great Green Fleet”; “Increase Efficiency Afloat”; and “Energy Efficient Acquisition.”

Report on Operational Energy Budget Certification for Fiscal Year 2012

The Navy’s target of “Increase Alternatives Afloat” focuses on supplying half of the Navy’s total energy consumption afloat from alternative sources by 2020. The Navy’s FY 2012 budget provides resources for Alternatives Fuels. Fuel Science & Technology efforts funded at \$6M in FY 2012 and \$31M across the FYDP include:

- Alternative fuels research to accelerate and enhance test and certification process for alternative fuels
- Biofuel research partnership with U.S. Department of Agriculture supporting the Department of the Navy-Department of Agriculture Memorandum of Understanding
- Collaborative alternative energy partnership with U.S. Department of Energy and other services through the U.S. Department of Defense/U.S. Department of Energy MOU
- Collaboration with other services through the TRI-Service Petroleum, Oils, and Lubricants Users Group

Other alternative power efforts accounting for more than a \$1M per year across the FYDP include Microbial, Biomolecular, and Sediment Fuel Cells. Navy also resources (\$16M FY 2012, \$88M FYDP) the Hybrid Electric Drive research, development, and fielding to improve the operating efficiency of the DDG 51 Class ships. Within this target, the Navy also provides \$16M in FY 2012 and \$72M across the FYDP for the testing and certification of fuels produced from renewable sources for aircraft and ship use. The chart below depicts the Navy’s Biofuel Engine Certification near-term timeline:



Report on Operational Energy Budget Certification for Fiscal Year 2012

The target of “Sail the Great Green Fleet” focuses on sailing a carrier strike group composed of nuclear ships, hybrid electric ships running biofuel, and aircraft flying on biofuel. Navy will demonstrate a Green Strike Group in 2012 and sail it as the "Great Green Fleet" in 2016. In addition to the investments noted under the “Increase Alternatives Afloat” target, the Navy funds \$3M in FY 2012 and \$29M across FYDP for procurement of renewable jet fuel and \$23M in FY 2012 and \$67M across the FYDP for procurement of alternative maritime fuel for these demonstrations.

The majority of the Department of the Navy’s FY 2012 budget funding towards operational energy improvements is focused on the “Increase Efficiency Afloat” target. This target seeks to increase efficiency and reduce overall fuel consumption afloat by 15 percent by 2020. The Navy’s Maritime Incentivized Energy Conservation Program (i-ENCON) which was implemented fleet-wide in 1999, provides ships with operational strategies and techniques to reduce fuel consumption and supports the Department of the Navy’s efforts to “Increase Efficiency Afloat”. The Naval Sea Systems Command (NAVSEA) provides ships the necessary i-ENCON training, tools and guidance which help to increase ships' underway operating hours by reducing overall fuel intensity. Additionally, i-ENCON reduces maintenance and repair through efficient operations and less redundant equipment operation resulting in reduced wear and tear. In FY 2010, the incentive-based i-ENCON program provided the Navy with the equivalent of 1.35M barrels (\$146M) of additional fuel and helped the Navy do more maintenance/repairs to maintain higher fleet readiness. The Department of the Navy has provided the i-ENCON program FY 2012 funding of \$500K and \$2.8M through the FYDP. The Navy is also developing a similar program for the aviation community, Air ENCON. Air ENCON is funded at \$2.1M in FY 2012 and \$13.1M through the FYDP.

Knowing when and where energy is being consumed is important when attempting to increase energy efficiency. In this regard, the Navy invests in the Plant Flow Monitoring system and Shore Power Management and Monitoring system. The Plant Flow Monitoring system addresses Military Sealift Command (MSC) and Navy ships’ limited ability to accurately meter fuel usage of diesel engines which restricts efforts to implement or quantify fuel savings strategies. The MSC Plant Flow Monitoring system corrects for density, technology, and air entrainment to measure fuel flow to an accuracy of around 0.01% error. This provides the ability to accurately monitor fleet fuel usage, analyze fuel and speed performance, and optimize throttle settings for best efficiency. The MSC Shore Power Management and Monitoring system integrates with the ship’s Mission Controls and Communications System, measures and stores energy and power quality data including cumulative kilo-Watt-hour, peaks, and several power quality metrics. The compiled data enables MSC to monitor and manage Shore Power usage and implement appropriate energy conservation measures. The Navy’s FY 2012 proposed budget provides \$3M in FY 2012 and \$11M through the FYDP for these systems.

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To meet the “Increase Efficiency Afloat” target in the future, Navy provides FY 2012 funding of \$91M and \$406M across the FYDP for Maritime Science and Technology efforts. These efforts include:

- Advanced turbine engine materials for improved efficiency
- Advanced, energy efficient ship power system architectures such as Next Generation Integrated Power System
- Shipboard technologies that provide efficiencies and reduce maintenance cost
- High temperature superconducting degaussing systems
- Advanced material, energy efficient propellers and waterjets
- Ship drag reduction and corrosion resistant surface treatment
- Long-endurance power systems and efficient designs for unmanned undersea vehicles

The Navy provides additional FY 2012 funding of \$31M and \$139M across the FYDP for Aviation Science and Technology efforts to include the Naval Variable Cycle Engine for aircraft engine efficiency, and long-endurance power systems and efficient designs for unmanned air vehicles.

The Navy also provides Operation & Maintenance and Procurement funding in the FY 2012 budget for operational energy related upgrades to the legacy maritime fleet in order to “Increase Efficiency Afloat.” FY 2012 funding of \$21M and FYDP funding of \$248M is provided for efforts such as:

- Easy-release hull coating systems that allows Navy ships with long pier-side periods to shed hull bio-fouling once underway
- Replacement of existing incandescent lighting fixtures on Amphibious ships, cruisers and destroyers with LED lights that will operate on less power for a much longer service life
- Hull appendages to eliminate directional stability and steering issues on LHA 1 and LHD 1 classes
- Fully digital Forced Draft Blower (FDB) monitoring and control system replacing obsolete SGA and manual damper controls for air fuel mixture for main propulsion boilers on LHA 1 and LHD 1 ship classes
- Easy-release coatings that remove biological growth on propellers while underway

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- Development and installation of stern flaps on LHD 1 and LSD 41/49 class ships
- Gas Turbine Online Waterwash system for CG 47 and DDG 51 class ships
- Allison 501K Efficiency Initiatives
- LM2500 Efficiency Initiatives
- Digital Fuel Control (DFC)

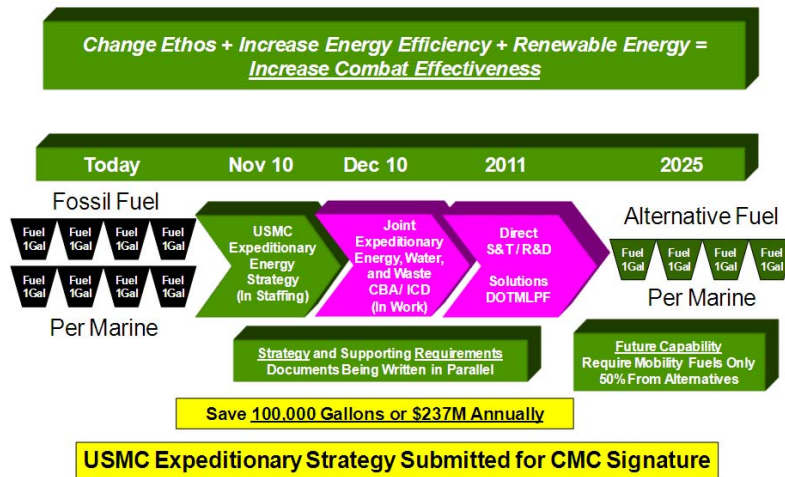
Additionally, the Navy invests in aviation simulator upgrades, \$64M in FY 2012 and \$325M through the FYDP, to deliver improvements in tactical training / combat effectiveness while enabling a reduction in Naval Aviation fuel expenditures.

The Navy's Goal of "Energy Efficient Acquisition" provides for the mandatory evaluation of energy factors when awarding contracts for systems and holding industry contractually accountable for meeting energy efficiency targets. We did not identify specific funding within the Department of the Navy's FY 2012 budget submission for this goal but recognize the successful implementation of this goal could have a significant impact on the Navy of the future being a mission-effective force in a logistics-constrained, anti-access environment.

USMC Operational Energy Program

The Marine Corps has budgeted \$42M in FY 2012 and approximately \$322M across the FYDP for operational energy initiatives. Approximately 8% of this funding is for Science and Technology efforts. The draft Marine Corps's Expeditionary Energy Strategy focuses on achieving greater combat effectiveness through energy efficiency, increased self sufficiency, and a reduced expeditionary footprint on the battlefield. The draft strategy aligns with the Secretary of the Navy's targets and supports the priorities for security, energy efficiency and environmental stewardship. The overall objective of the draft USMC strategy is to reduce by 50% the liquid fuel required on the battlefield by 2025.

Energy Strategy POA&M "Bases-to-Battlefield"



To achieve this, the Marine Corps is pursuing four principal goals— instill an ethos of energy efficiency in every Marine, Lead and Manage Expeditionary Energy, increase energy efficiency of equipment, and meet operational demand with renewable energy. These goals provide the framework for considering funding of the USMC’s Expeditionary Energy Strategy, and are applicable to FY 2012 Operational Energy Budget Certification.

The USMC target of achieving 50% increase in efficiency by 2025 is supported by the four goals, and associated initiatives. Benchmarks are phased over the next 15 years, at 25% by 2015, 40% by 2020, and 50% by 2025.

		<i>Efficiency Gains</i>		
		<i>E² GOALS</i>	2015	2020
Bases & Battlefield	Embed E² into USMC Ethos			
	Lead and Manage E²			
Battlefield	Increase Energy Efficiency of Weapons Systems, Platforms, Vehicles and Equipment	25%	40%	50%
	Meet Operational Demand With Renewable Energy			

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The USMC's goals to Instill Ethos and Lead and Manage Expeditionary Energy focuses on institutionalizing expeditionary energy priorities through leadership, training, and driving the requirements and acquisitions processes. In support of strategy development, implementation and other operational support, the USMC provides Operation & Maintenance funding in FY 2012 of \$4.6M and FYDP funding of \$28.0M to support the Expeditionary Energy Office (E2O) and provide operational support for development and implementation of the Energy Strategy, to include:

- USMC Expeditionary Energy Strategy and Implementation Planning Guidance
- Expeditionary Energy, Water, and Waste Initial Capabilities Document/Capabilities Based Assessment
- Implementing energy efficiency KPP in the Ground Based Operational Surveillance System (G-BOSS) Capability Development Document
- Experimental Forward Operating Base (ExFOB); identification, evaluation, and fielding of energy efficient capabilities, and renewable energy solutions for the battlefield.

The USMC's FY 2012 Budget provides funding for initial material investments to achieve goals for Energy Efficiency in Equipment and for meeting Operational Energy Demand with Renewable Energy by 2025. The USMC provides procurement funding in FY 2012 of \$30.0M and FYDP funding of approximately \$244.8M, which will support the following program activities:

- Implementing mobile power sources to achieve 20% fuel efficiency improvement, beginning in 2010 (Army funded development/USMC funded procurement)
- Fielding Enhanced Efficiency Environmental Control Units (E3CU) to achieve 15-30% power efficiency improvement, beginning in 2011. Next generation family of environmental control units (ECUs) will begin entering service in 2014
- Implementing deployable renewable energy alternative modules and ground renewable expeditionary energy systems
- Implementing improved environmental control units in vehicles and trailers (e.g. MRAPs/LAVs)
- Developing hybridization and other fuel economy improvement engineer change proposals for MTRVs to reduce the total ownership cost
- Implementing energy efficient shelters and lighting.

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USMC is also making S&T and RDT&E investments to drive future capabilities in efficiency and renewable energy. The USMC provides RDT&E funding in FY 2012 of \$7.0M and FYDP funding of \$49.2M, to support the following efforts:

- Improved power density in battery, chargers, and power adaptors for highly mobile forces.
- Advanced integrated solutions for electrical power generation and distribution.
- Lightweight Power Systems for Dismounted Marine Squad Applications.


The Assistant Secretary of Defense for Operational Energy Plans and Programs assessment of the adequacy of the funding for operational energy requirements in the Department of the Navy’s proposed FY 2012 budget to its energy strategy and targets is shown below:

Department of the Navy	
Operational Energy Targets	Rating
Increase Alternatives Afloat	Green
Sail the Great Green Fleet	Green
Increase Efficiency Afloat	Green
- Current/Near-term Efforts	Green
- Monitoring & Measuring Efforts	Green
- S&T Efforts	Green
- Legacy Fleet Efforts	Green
USMC Expeditionary Efforts	Green
Energy Efficient Acquisition	Yellow

To strengthen its operational energy efforts, the Department of the Navy should demonstrate “Energy Efficient Acquisition” efforts and the associated operational energy savings. The Assistant Secretary of Defense for Operational Energy Plans and Programs certifies the Department of the Navy FY 2012 budget adequately funds its Energy Strategy. The Department of the Navy the FY 2013 budget will be certified against the Department of Defense’s *Operational Energy Strategy*. This may require additional operational energy efforts to be budgeted for in the FY 2013 budget in order to achieve a certified budget.

Department of Air Force Operational Energy Budget Certification

The Department of the Air Force budgeted \$261M in FY 2012 and approximately \$922M across the FYDP for operational energy initiatives. All of this funding is for Science and Technology efforts. The Department of the Air Force has a three-part Energy Strategy: Reduce Demand, Increase Supply, and Change the Culture. Each part of the strategy has Goals within the domains of Aviation; Infrastructure; and Acquisition, Science and Technology as shown in the chart below:



Air Force Energy Goals

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	Reduce Demand	Increase Supply	Change the Culture
Aviation	<ul style="list-style-type: none"> Reduce consumption of aviation fuel by 10% by 2015 Implement pilot fuel efficiency measures in all standardization/evaluation flights by 2010 Incorporate pilot fuel efficiency elements into the UPT training syllabus by 2011 	<ul style="list-style-type: none"> By 2016, be prepared to cost competitively acquire 50% of AFs domestic aviation fuel requirement via an alternative fuel blend 	<ul style="list-style-type: none"> Provide energy leadership through EMSGs Train all personnel in energy awareness by 2010 Implement an energy curriculum at USAFA/Air University by 2010 Communicate energy awareness during Energy Awareness Month
Infrastructure	<ul style="list-style-type: none"> Reduce motor vehicle fleet petroleum fuel use by 2% per annum Reduce installation energy intensity by 3% per annum 	<ul style="list-style-type: none"> Increase non-petroleum- based fuel use by 10% per annum in motor vehicle fleet Increase facility renewable energy at annual targets to reach 25% by FY2025 	
Acquisition, Science and Technology		<ul style="list-style-type: none"> Test/certify all aircraft and systems against 50/50 alt fuel blend by 2011 	


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The Goals applicable to FY 2012 Operational Energy Budget Certification include: Reduce consumption of aviation fuel by 10% by 2015; by 2016, be prepared to cost-competitively acquire 50% of the Air Force’s domestic aviation fuel requirement via an alternative fuel blend; and test and certify all aircraft and systems against 50/50 alt fuel blend by 2011.

The Department of the Air Force further provides the following ways and means to execute the Goals applicable to the Operational Energy Budget Certification: Implementing Goals, Energy Optimization Pillars, Objectives for “Aviation Pathways”, “Acquisition Pathways for Legacy Systems”, and “Acquisition Pathways for Research and Design” to expound upon and provide ways and means to execute the Goals. Each of these areas provides specific ways and means applicable to the Operational Energy Budget Certification.

The “Aviation Pathways” Implementing Goals, Energy Optimization Pillars, and Objectives are shown below:



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Air Force Energy Goals: Aviation Pathways

	Reduce Demand		Increase Supply	
Implementing Goals	<ul style="list-style-type: none"> Reduce consumption of aviation fuel by 10% by 2015 	<ul style="list-style-type: none"> Implement pilot fuel efficiency measures in all standardization /evaluation flights by 2010 	<ul style="list-style-type: none"> Incorporate pilot fuel efficiency elements into the UPT training syllabus by 2011 	<ul style="list-style-type: none"> By 2016, be prepared to cost competitively acquire 50% of AFs domestic aviation fuel requirement via an alternative fuel blend
Energy Optimization Pillars	Provide Leadership in Energy Management	Fly/Operate Efficiently	Instill Energy Awareness	Maximize the Use of Technology for Energy Efficiency
Objectives	<ul style="list-style-type: none"> Communicate Priorities Facilitate Initiatives Identify Best Practices Develop Guidance Create Transparent Environment Provide Incentives Provide Path to Achieve Goals Ensure Accountability 	<ul style="list-style-type: none"> Reduce Weight Use Fuel Conservatively Utilize Simulators Consider Ground Transportation Strategically Distribute Assets Optimize Refueling Optimize Routing and Descents 	<ul style="list-style-type: none"> Educate Aircrew Demonstrate Correlation Between Energy and Safety Consolidate Energy Information Provide context Reevaluate Training Program Culture Change 	<ul style="list-style-type: none"> Optimize Use of Engine Performance Data Integrate Advanced Design Systems Develop Data Collection and Analysis Programs

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Most of the Objectives within the “Aviation Pathways” are ‘other than Materiel’ Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMIL-PF) solutions which require minimal investments or expenditures in the FY 2012 budget but significantly contribute to immediate demand reduction in current operations. Air Force’s efforts towards these objectives in the FY 2012 budget result in savings in FY 2012 of \$494M and through the FYDP of \$2.6B. Examples of ‘other than Materiel’ DOTMIL-PF solutions resulting in significant savings include: optimizing aircraft centers of gravity, diplomatic cleared routing, European routing, aircraft crew ratios, and departure over fuels which together result in FY2012 and FYDP savings of \$59M and \$295M respectively. The greatest reduction in operational energy demand is garnered through the Air Force’s increased use of simulators which allows flying hour adjustments resulting in estimated FY 2012 and FYDP savings of \$368M and \$2.0B respectively.

Monitoring and measuring efforts are vital when attempting to reduce energy demand or gain energy efficiencies. Valid data provides the basis for optimization decisions. In this regards, the Department of the Air Force has objectives within the “Aviation Pathways” to

optimize the use of engine performance data and develop data collection and analysis programs. The Department of the Air Force has not resourced improvements to current data collection and development programs.

Increasing the energy efficiency of the current legacy fleet presents the greatest opportunity for optimizing use of operational energy past the ‘other than Materiel’ DOTMIL-PF solutions discussed above. The Department of the Air Force’s Implementing Goals, Energy Optimization Pillars, and Objectives for “Acquisition Pathways for Legacy Systems” provides the ways and means for this reduction and they are shown below:



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Air Force Energy Goals: Acquisition Pathways – Legacy Systems

Legacy Systems				
Implementing Goals	<ul style="list-style-type: none"> Reduce Fuel Burn by 5% by 2016 	<ul style="list-style-type: none"> Reduce Fuel Burn by 10% by 2020 	<ul style="list-style-type: none"> Reduce Fuel Burn by 20% by 2030 	<ul style="list-style-type: none"> 50% alt aviation fuel blend by 2016,
Energy Optimization Pillars	Near-Term Modifications	Mid-Term Modifications	Long-Term Modifications	Alt Fuel Cert
Objectives	<ul style="list-style-type: none"> Improve engine fuel efficiency using OTS tech Improve aircraft fuel efficiency using OTS Tech Develop improved mission planning Accelerate aging aircraft replacement 	<ul style="list-style-type: none"> Integrate upgrades of commercial engines in to legacy aircraft Develop improved engine components Develop aircraft modifications to reduce drag Develop advanced subsystems and components Implement light-weight materials Identify advanced engine component development 	<ul style="list-style-type: none"> Transition advanced lab technologies into legacy aircraft Transition advance engine technologies into legacy systems 	<ul style="list-style-type: none"> Certify alternative fuels and fuel blends as drop-in replacement fuels Ensure all new aircraft are certified to use alternative fuels and fuel blends

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The Department of the Air Force has not budgeted for the near-term and mid-term modifications to legacy systems in order to reduce operational energy demand in the FY 2012 budget. Nevertheless, the Air Force has resourced numerous technologies in its research and development efforts which may result in reduced legacy system operational energy demand in the future. These efforts are addressed within the “Acquisition Pathways for Research and Design.”

The “Acquisition Pathways for Legacy Systems” includes objectives to certify alternative fuels and fuel blends as drop-in replacement fuels and ensure all new aircraft are certified to use alternative fuels and fuel blends. In regards to these objectives, the Department of the Air

Force will complete certification of aircraft, vehicles, and fuel delivery systems to use 50-50 blends of conventional and Fischer-Tropsch-derived fuels in FY 2011. Certifications of blends of Hydrotreated Renewable Jet (HRJ) fuels will be completed in FY 2012. The Air Force has not budgeted funds to specifically acquire alternative fuels to meet its FY 2016 goal because the goal specifies that the fuels be cost-competitive which means they will be acquired within the Air Force’s existing fuel budget.

The Air Force’s Implementing Goals, Energy Optimization Pillars, and Objectives for “Acquisition Pathways for Research and Design” are shown below:



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Air Force Energy Goals: Acquisition Pathways – Research & Design

Research & Development					
Implementing Goals	<ul style="list-style-type: none"> • 20% Increase in Lift-to-Drag ratio by 2016 		<ul style="list-style-type: none"> • Reduce Installed Specific fuel consumption by 25% by 2016 		<ul style="list-style-type: none"> • Certify systems for alt aviation fuel by 2011
Energy Optimization Pillars	Alt Fuels Evaluation	Aircraft Tech	Efficient/ Adaptive Engine Tech	Advanced Design Systems	
Objectives	<ul style="list-style-type: none"> • Test F-T/JP-8 blend • Certify Fleet on F-T/JP-8 blend • Evaluate biofuels for CO2 reduction • Evaluate pure synthetic fuels • Material compatibility 	<ul style="list-style-type: none"> • Increase aero efficiency <ul style="list-style-type: none"> – Reduce Weight – Longer Rang Missions – Increase lift-to-drag ratio • Advance light-weight materials 	<ul style="list-style-type: none"> • Reduce installed specific fuel consumption • Increase thrust-to-weight ratio • Improve thermal management 	<ul style="list-style-type: none"> • Design energy conversion systems to be fuel-flexible • Pursue proactive partnerships with energy suppliers for timely deployment of new technology 	

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The Implementing Goals of a 20% Increase in Lift-to-Drag ratio by 2016, Reduce Installed Specific fuel consumption by 25% by 2016, and Certify systems for alternative aviation fuel by 2011 apply to the entire fleet and are addressed in the FY 2012 budget through investment in a number of science and technology efforts. They are resourced in the Research, Development, Test & Evaluation, Air Force (RDT&E, Air Force) appropriation, encompass Basic Research through Advanced Technology Development programs, and total to FY 2012 funding of \$247M and FYDP funding of \$908M.

FY 2012 budget investments focused on reducing weight, extending mission ranges, increasing lift-to-drag ratios, and designing advance lightweight materiel to address the

Implementing Goal of a 20% Increase in Lift-to-Drag ratio by 2016. These investments total to FY 2012 funding of \$2.1M and FYDP funding of \$10.3M. Efforts in this area include:

- Develop a family of affordable lightweight materials, including metals, polymers, ceramics, metallic and nonmetallic composites, and hybrid materials to provide upgraded capabilities for existing aircraft, missile, and propulsion systems to meet the future system requirements
- Develop design methods to capitalize on new materials, multirole considerations, and integration of various subsystem hardware items and adaptive mechanisms into the actual aircraft
- Develop aircraft structures that have embedded components, which have previously been separate components that were attached to the air platforms
- Develop adaptive structures to provide in-flight modifications offering improved performance

FY 2012 budget investments in the Adaptive Versatile Engine Technology (ADVENT) and Highly Efficient Embedded Turbine Engine (HEETE) focus on Efficient and Adaptive Engine Technology through reduced installed specific fuel consumption, increased thrust-to-weight ratios and improved thermal management to address the Implementing Goal of “Reducing Installed Specific fuel consumption by 25% by 2016.” These investments total to FY 2012 funding of \$94M and FYDP funding of \$361M.

- The ADVENT program seeks to develop an advanced turbine engine that automatically adjusts fan airflow and pressure ratio for optimized performance and fuel efficiency at all flight conditions. Operational assessments indicate that the ADVENT engine would have the potential to increase range by twenty-five percent and time-on-station for the Long Range Precision Strike, to increase supersonic range and subsonic loiter in the 6th Generation TACAIR and to increase CTOL range by thirty percent and close air support time on station by thirty-three percent for the F-35 Joint Strike Fighter. The program is resourced for a full engine demonstration in FY 2013.
- The HEETE program is the next quantum step beyond and is enabled by ADVENT. The program’s goal is to provide a ten percent increase in fuel efficiency beyond ADVENT, a fifty percent increase in transport range and an eighty percent increase in payload.

However, we note engine technology programs, while improving efficiency, have historically been used to make aircraft heavy and more capable rather than reduce fuel consumption or

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increase endurance. The extent to which energy efficiencies are recognized will depend greatly upon the final aircraft configuration and mission.

The Acquisition Pathways for Research and Design includes objectives to evaluate biofuels for carbon dioxide reduction and evaluate pure synthetic fuels. To address these objectives, the Department of the Air Force proposed directing FY 2012 budget resources to alternative fuels evaluation at the Air Force Research Laboratory (AFRL). This funding amounts to \$13M in FY 2012 and \$70M across the FYDP.

The Department of the Air Force also invests in research and development for expeditionary base technologies. FY 2012 budget investments in this area amount to \$1.6M in FY 2012 and \$8.6M through the FYDP. Efforts in this area include: Investigating and developing innovative airbase operational energy capabilities such as integrating and demonstrating photovoltaics on shelter systems, grid power conditioning, and distribution methods such as wireless power system capable of line-of-sight energy transfer.

The Assistant Secretary of Defense for Operational Energy Plans and Programs assessment of the adequacy of the funding for operational energy requirements in the Department of the Air Force’s proposed FY 2012 budget to the departments’ goals and objectives is shown below:

Department of the Air Force	
Operational Energy Goals/Objectives	Rating
Reduce Demand	Yellow
- Aviation Pathways	Yellow
- Current/Near-term Efforts	Green
- Monitoring & Measuring Efforts	Red
- Acquisition Pathways - Legacy Systems	Red
- Acquisition Pathways - Research & Design	Green
Increase Supply	Green
- Acquisition Pathways - Legacy Systems	Green
- Acquisition Pathways - Research & Design	Green
Expeditionary Base Efforts	Green

To strengthen its operational energy efforts, the Department of the Air Force should budget for the development and improvement of data collection and analysis programs to improve Monitoring and Measuring Efforts, and identify and budget for energy efficiency improvements to legacy systems. The Assistant Secretary of Defense for Operational Energy Plans and Programs certifies the Department of the Air Force’s FY 2012 budget meets its Energy Strategy. The Department of the Air Force the FY 2013 budget will be certified against the Department of

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Defense's *Operational Energy Strategy*. This may require additional operational energy efforts to be budgeted for in the FY 2013 budget in order to achieve a certified budget.