



U.S. AIR FORCE



AIR FORCE AVIATION OPERATIONS ENERGY PLAN 2010





The Aviation Operations Energy Plan, an appendix to the Air Force Energy Plan, serves as the operational framework for all military and civilian Air Force personnel in communicating aviation energy goals, objectives, and metrics. The Aviation Operations Energy Plan aligns with the goals outlined in the Air Force Energy Plan, the Air Force Strategic Plan, and is aligned under the Agile Combat Support Master Plan. The Aviation Operations Energy Plan supports the Air Force Policy Directive (AFPD) 90-17, *Energy Management* and Air Force Instruction (AFI) 90-1701, *Energy Management*. The Deputy Chief of Staff, Operations, Plans and Requirements (AF/A3/5) is the Office of Primary Responsibility (OPR) for the Aviation Operations Energy Plan.

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1 Aviation Operations: Mission in Relation to Energy

The U.S. Armed Forces are the most effective military forces in the world. Protecting democracies and responding to international threats require responsiveness on a global scale. Transporting troops to their strategic destinations requires significant amounts of energy; therefore, factoring energy management into aviation operations is a critical component of mission execution.

America's Airmen proudly contribute to the Global Vigilance, Reach, and Power that is necessary to respond to security threats around the world. The Air Force makes critical contributions to all the U.S. Armed Services, moving troops and cargo to, from, and within theater; delivering supplies and equipment to Joint and Coalition forces with unprecedented accuracy; providing protection to troops from above; and conducting combat support in the most challenging environments.

Across all Air Force mission areas, energy is the common denominator. Energy is a mission-critical component of aviation operations and, as such, must be managed to ensure sustained mission readiness and responsiveness on a global scale. Increasing global demand and uncertainty of dependable energy supplies highlights why energy security represents a national security issue. As the largest consumer of fuel in the Department of Defense (DoD), the Air Force must ensure that it optimizes energy efficiencies and conservation initiatives across the chain of command.

Aviation operations account for approximately 84 percent of the energy used by the Air Force each year. Aviation operations focus on all flying, planning, and training programs within the Air Force;

however, fuel efficiency and energy conservation must be incorporated into the Air Force's standard operating procedures as higher priorities. Energy awareness must be integrated into the Air Force's operations from policy guidance contained within Air Force Instructions and Policy Memoranda, to flight procedures implemented at the squadron level.

To decrease reliance on foreign oil and to ensure an energy-conscious environment, the Air Force developed an Energy Plan with three goals: *Reduce Demand, Increase Supply, and Culture Change*. With the Air Force Energy Plan laying the foundation for energy management throughout the chain of command, the Air Force will develop demand-side energy efficiency measures, establish a long-term commitment to supply-side alternative energy sources, and transform the culture to take energy into consideration across all operational activities. On the supply side, the Air Force established programs in renewable energy and alternative fuels, with the Air Force often leading research, development, and deployment of cutting-edge energy technologies. On the demand side, there are programs in energy efficiency and conservation, aerodynamics optimization, and awareness and training.

The Deputy Chief of Staff, Operations, Plans and Requirements (AF/A3/5) established and executes the Air Force's Aviation Energy Program. AF/A3/5 developed goals, objectives, and metrics associated with aviation and ground operations, whereby energy considerations are factored throughout Air Force aviation and ground operations. Institutional changes in energy policies and

aviation operational procedures are required to achieve these goals. The Aviation Operations Energy Plan aligns with the primary mission of the Air Force, as well as the overall goals, objectives, and metrics of the Air Force Energy Plan.

The Aviation Operations Energy Plan is comprised of four “Pillars” that represent areas where energy optimization can occur:

- **Pillar 1**—Provide Leadership in Energy Management
- **Pillar 2**—Fly/Operate Efficiently
- **Pillar 3**—Instill Energy Awareness
- **Pillar 4**—Maximize the Use of Technology for Fuel Efficiency

Meeting the objectives of the Aviation Operations Energy Plan requires the combination of multiple elements—leadership, program development, investments in innovation, technology development and deployment, alternative energy supply chains, decreasing demand by maximizing efficiencies, and individual efforts—to ensure the Air Force can sustain mission readiness and responsiveness. The Aviation Operations Energy Strategic Plan integrates these elements into a cohesive framework that ensures the Air Force remains a leader in energy management. But in order for the Aviation Operations Energy Plan to transform from a framework to an implementation device, the Air Force will rely on all Airmen to recognize and create opportunities to conserve energy and be prepared to execute the Air Force’s overarching energy goals: Reduce Demand, Increase Supply, and Culture Change in their daily activities.

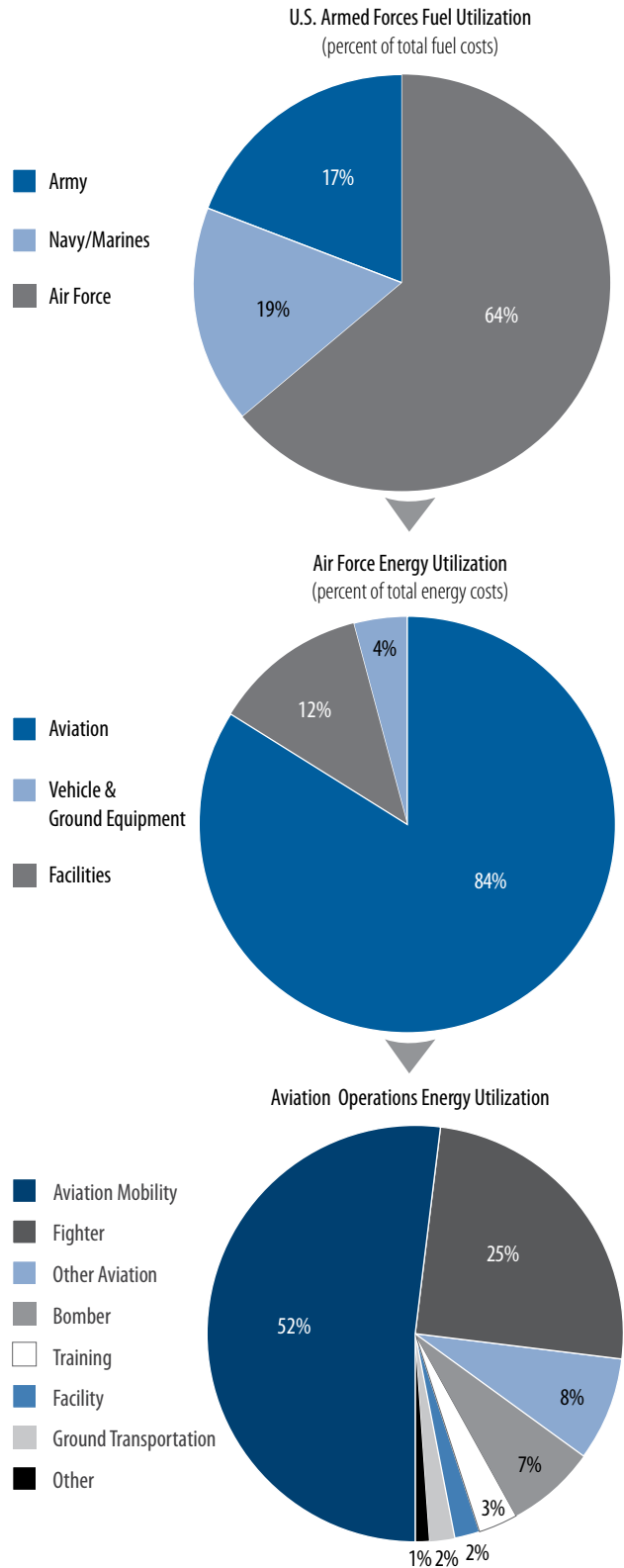
Synopsis of Aviation Operations Energy Use

Aviation operations account for the bulk of the fuel used by the Air Force and rising energy costs are consuming a larger percentage of the Air Force’s annual budget. Therefore, fuel efficiency must be incorporated into the standard operating procedures of Air Force aviation operations as a higher priority. Assessing the energy requirements of training and in-theatre operations will provide the Air Force with a measurable baseline upon which fuel efficiency improvements can be built.

Figure 1 provides a snapshot of energy consumption across DoD and within the Air Force. The Air Force accounts for approximately 64 percent of fuel consumed by the U.S. Armed Services, and thus the Air Force recognizes its role in providing leadership in energy management and conservation within the DoD community.

Within the Air Force, aviation operations accounts for approximately 84 percent of energy consumption, primarily as a result of the magnitude of jet fuel consumed as a result of aviation mission requirements. Aircraft require large amounts of energy for mission execution, and as is indicated within Figure 1.

Figure 1 Energy utilization across the Armed Forces and Aviation Operations (FY2009)





2 Scanning the Environment

Scanning the Environment

The Air Force has long recognized the need to incorporate energy management into its operations. A rapidly evolving energy landscape with new federal legislation required a review of the Air Force's energy policy. Air Force Policy Directive (AFPD) 90-17, *Energy Management*, was signed in July 2009, superseding AFPD 23-3, *Energy Management*, signed in September 1993. AFPD 90-17 creates an energy management framework across Air Force operational areas and defines responsibilities across all organizations in the Headquarters Air Force (HAF). Air Force Instruction (AFI) 90-1701, *Energy Management*, implements AFPD 90-17 by providing the cross-functional governance and management structure at all levels of the Air Force necessary for the execution of the Air Force Energy Plan and Energy Policy.

Currently there are no federal statutes or DoD policies that regulate aviation fuel consumption or emissions. Despite the lack of regulatory requirements, the Air Force understands that it must address aviation operations with respect to energy management, otherwise a major component of Air Force energy usage would be left out. Proactive leadership is necessary to ensure that this gap in energy management within the Air Force will not emerge. AF/A3/5 issued an Aviation Fuel Conservation Policy Message on September 21, 2006, outlining areas where energy management mechanisms can be integrated across major commands (MAJCOMs) with respect to aviation operations. The Air Force is

committed to providing energy leadership across supply-and-demand energy chains, adopting any future energy policies that address aviation energy consumption and fostering a more sustainable energy future.

Additionally, AF/A3/5 published an Aviation Fuel Optimization Culture memo in September 2006, whereby senior Air Force leadership outlined focus areas to eliminate inefficiencies in aviation operations and optimize fuel use.

The main focus areas for creating an aviation fuel optimization culture are:

- **Flying Hour Program**—With the planned 10 percent reduction in flying hours across the Future Years Defense Program (FYDP), it is critical that missions terminate after training is completed. The Annual Flying Hour Program Guidance that AF/A3/5 distributes reiterates that excess flying hours can be returned to the MAJCOM or HAF, if necessary.
- **AFI 11-2 Mission Design Series (MDS), Volume 3 Updates**—MAJCOMs are responsible for providing updates to their specific AFI 11-2 MDS Volume 3, so that these Instructions address Air Force conservation and optimization policy. Air Force fuel conservation and optimization techniques include: reducing excessive ramp and recovery loads, elimination of carrying excess fuel, and incorporation of fuel efficiency considerations during flight planning and flight routing. AF/A3/5 provides specific guidance to the MAJCOMs on fuel

conservation policy language to incorporate into their AFI 11-2 MDS, Volume 3 updates. Fuel Conservation. Airmen and mission planners will manage aviation fuel as a limited commodity and precious resource. Fuel optimization will be considered throughout all phases of mission planning and execution. Airmen should employ the following fuel optimization measures without compromising flight safety or jeopardizing mission/training accomplishment:

- **Optimize fuel loads**—Mission plan for the required ramp and recovery fuel. Excessive ramp and recovery fuel adds to aircraft gross weight and increases fuel consumption. Ensure ramp fuel is correct upon arrival at aircraft. Do not carry extra fuel beyond optimum requirements for safe mission accomplishment and training objectives.
- **Minimize Auxiliary Power Unit (APU) Use**—Use ground power units when practical.
- **Delay Engine Start Time**—Establish and implement local engines start time standards.
- **Optimize Load Configurations**—Minimize aircraft weight through optimized fuel loads and reduction of equipment not necessary to accomplish the mission.
- **Establish Command and Control (C2) and Flight Procedures**—Airmen and mission planners should optimize flight plans and flight routing for fuel efficiency. In-flight procedures, such as climb/descent profiles and power settings, should also be considered for efficient fuel usage. Timely notification of mission changes/cancellations should be communicated to avoid unnecessary or unproductive flight time.
- **Airmen Evaluations**—Fuel conservation will be an interest item on all Airmen evaluations. Evaluators will reinforce the importance of optimizing fuel loads, start/taxi procedures, and fuel efficient mission execution.

Fuel optimization not only saves resources and money, but also enhances the Air Force's ability to apply combat power more efficiently and effectively. Actions taken by the Air Force, however small, will go a long way toward enhancing the mission effectiveness of the world's greatest air and space force.

Energy Security

The Air Force is engaged every day in global operations; fighting overseas contingency operations; defending our homeland; providing strategic deterrence; and giving our nation unparalleled Global Vigilance, Reach, and Power. Air Force global expeditionary air, space, and cyberspace forces provide vigilance that is persistent, focused, and predictive; reach that is reliable, rapid, and agile; and power that is precise, stealth, and decisive.

Energy is a strategic resource that has significant security, economic, geo-strategic, and environmental implications for the nation and important operational implications for the Air Force. Increasing global demand and uncertainty of dependable supply has highlighted petroleum-based energy as a national security

issue. To decrease reliance on foreign oil and enhance our nation's energy security, the Air Force is implementing its strategy to achieve its goals to Reduce Demand, Increase Supply, and Culture Change. By integrating demand-side energy efficiency measures alongside supply-side alternative energy sources, the Air Force will fundamentally change the way it manages energy by encouraging a culture of energy responsibility. Aviation operational readiness is contingent upon energy availability, and thus the Air Force must employ comprehensive energy management strategies to minimize energy-related vulnerabilities.

The size of the Air Force's demand for energy creates risks as well as opportunities. The Air Force can work to increase energy security through strategic resilience by shifting reliance toward alternative and renewable sources of energy; reducing dependence on non-assured sources of oil; stabilizing and reducing the Air Force's operational energy demand; and leveraging efforts by other organizations, such as federal agencies, industry, academia, and the international community.

The Air Force is a major contributor to advances in alternative and renewable energy technology research, development, and deployment. In December 2007, the Air Force commissioned the largest photovoltaic solar array in the United States (14.2 megawatts) at Nellis Air Force Base. The Air Force is the largest green power purchaser in the federal government, using energy from wind, solar, geothermal, and biomass to meet a portion of base-wide electrical requirements. The Air Force continues to assess how underutilized land can become the platforms for additional renewable energy projects.



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In terms of aviation operations, the Air Force has certified B-1, B-52, C-17, F-15, and F-22 to use a synthetic 50/50 blend of alternative fuel. The Air Force's goal is to certify the entire fleet by early 2011.

Energy security is a work-in-progress; there are no silver bullet solutions, but rather an array of energy management options that lead to energy efficiency and innovation.



Blended fuel testing of all Air Force operational platforms that require fuel is an on-going process, with full certification of the C-5, T-38, and KC-135 systems expected in the near future.

Energy Consumption & Costs

Aviation operations account for the bulk of the fuel used by the Air Force and rising energy costs are consuming a larger percentage of the Air Force's annual budget. Therefore, fuel efficiency must be incorporated into the standard operating procedures of Air Force aviation operations as a higher priority. Assessing the energy requirements of training and in-theatre operations will provide the Air Force with a measurable baseline upon which fuel efficiency improvements can be built.

The primary aviation goal is to reduce aviation fuel-use by 10 percent (from a 2006 baseline) by 2015. Accomplishing this goal will require the integration of the three primary goals of the Air Force Energy Plan: Reduce Demand, Increase Supply, and Culture Change. On the supply side, the Air Force has programs in renewable energy and alternative fuels. On the demand side, there are programs in energy efficiency and conservation. For culture change, there are energy awareness initiatives being executed across the Air Force.

Multiple techniques exist for establishing a firm foundation of energy optimization through Air Force aviation operations. From flight simulator utilization to aircraft weight configuration, the power to positively change the way the Air Force uses energy is directly in the hands of ground and aircraft operators. From the Secretary of the Air Force to the individual airman, energy management is part of the Air Force strategy to protect this country from vulnerabilities and enhance energy independence through a range of initiatives.

Technological Change

Changes in technology are unlikely to significantly alter the energy balance away from fuels derived from crude oil for decades. Yet, there are readily available technologies that can be applied to aircraft to enhance the energy efficiencies associated with aviation operations. Efforts to ensure that fuel is burned efficiently include aircraft design improvements. Optimized aerodynamics of different

aircraft types, including radically new aircraft wing and body configurations are made possible with the advent of new materials. Advancements in materials engineering allow for the use of lighter, stronger alloys and composite materials in aircraft construction, thereby reducing aircraft structural weight and improving energy efficiency. Advancements in propulsion and engine technologies have resulted in the use of high bypass turbofans that realize dramatic improvements in the amount of thrust generated per gallon of fuel.

Improvements in mission capabilities have resulted in reductions in fleet size. Advanced avionics, precision-guided munitions, unmanned aerial systems, and other technologies have revolutionized airpower, resulting in a reduced force structure of more capable aircraft, and accomplishing missions with greater success and survivability.

Innovative use of flight simulators includes benefits beyond fuel conservation, including extended airframe life due to less hours flown for training; reducing the number of airframes dedicated for training, which frees aircraft for real-world missions; the ability to train Airmen in mission profiles that are not practical or safe to perform in an aircraft; and the capability for Airmen to review, analyze, and debrief performance for a better learning and training experience.

Renewable Energy & Market Forces

In an effort to increase green alternatives as well as decrease reliance on foreign oil, the Air Force has challenged industry and academia to develop and optimize domestic fuel options. One process for developing alternative fuel, known as the Fischer-Tropsch process, uses coal, natural gas, or biomass in producing more environmentally-friendly alternatives to petroleum-based fuels. Fuel produced through the Fischer-Tropsch process burns cleaner than petroleum products and produces fewer particulates and no sulfur dioxide.

The Air Force is exploring whether synthetic fuels can be used in aircraft. To date, the B-1, B-52, C-17, F-15, F-22, and all Air Force ground support equipment have been approved for unrestricted operations using a 50/50 blend of synthetic fuel and standard JP-8. Testing of all Air Force operational platforms that require fuel is an on-going process, with full certification of the C-5, T-38, and KC-135 systems expected within the near future. In addition, dedicated six-month Field Service Evaluations of base-level fuel storage/delivery systems and the F-15 weapons system are currently underway to develop long-term durability data related to the synthetic blend fuel.

The Air Force has served as a critical catalyst for helping alternative fuels mature by providing industry incentives and testing and certifying new fuels. In January 2009, the Air Force started a program to certify synthetic fuels for aviation use. This effort will promote environmental sustainability as the greenhouse gas emissions associated with the production and use of these types of fuels is significantly lower than petroleum-based products. Numerous companies have shown a significant interest in partnering with the Air Force in the effort. If such endeavors could acquire financing, the aggregate stream of alternative aviation jet fuel could approach the amount necessary to meet the Air Force stated goal to acquire 50 percent of domestic crude oil-derived jet consumption *via* an alternative fuel blend by 2016. The Air Force intends to acquire domestically produced alternative jet fuels in commercial quantities that are cost competitive and have a greener overall environmental footprint than currently available petroleum-based fuel.

Asset Management Transformation

Asset management directly relates to energy optimization throughout aviation operations. Asset management involves a structured, strategic approach for deciding how to optimize assets to gain their maximum performance. From air refueling to routing and weight configurations, the Air Force is reassessing its aviation operational procedures to determine how to maximize mission performance while simultaneously reducing energy requirements.

From aircraft to ground equipment, aviation operations depend on energy to execute missions. Incorporating operational efficiencies across aviation operational areas will enhance Air Force's ability to effectively manage one of its most critical assets: energy.

Aviation fuel optimization entails identifying tangible energy efficiency techniques that can be applied to aviation operations equipment. This includes, but is not limited to accessing the load configurations of aircraft and identifying areas where weight reductions can be achieved, maximizing the use of flight simulators for training exercises, incorporating advanced aerodynamics and avionics design systems in aircraft, and incorporating direct routing into flight plans.

There are tactical as well as financial advantages associated with using less fuel for flights. Aviation operational efficiencies can result in freeing up financial resources associated with fuel costs, which can then be deployed for enhancing tactical capabilities, such as technology development and deployment.

The Air Force is the largest consumer of fuel in DoD, and aviation operations account for the majority of this consumption. The Air Force must examine every aspect of fuel consumption while maintaining core competencies and power projection capabilities. Fuel savings will yield future capabilities and mission execution improvements. The Air Force has an obligation to conserve energy to minimize negative impacts on the global environment as well as to respond to budgetary constraints and be prudent in the use of scarce resources.



Aviation fuel optimization identifies tangible energy efficiency techniques that can be applied to aviation operations, including maximizing the use of flight simulators for training exercises.



3 Energy Focus Areas for Aviation Operations

Energy Focus Areas

AFPD 90-17 and AFI 90-1701 establish the policy and program framework for energy management across all Air Force operational areas. Within aviation operations, a set of clear and concise energy program focus areas include:

- **Alternative Fuel Use**—Alternative fuel use will increase by 10 percent per year. Alternative fuels may be derived from biomass, coal, or other sources provided they have a lower life cycle greenhouse gas emission footprint than the conventional fuels they replace. The baseline for measuring the increase will be FY2005.
- **Aviation Fuel Strategy and Optimization**—Aviation operations will develop strategies to optimize fuel use during training and mission operations. Strategies will not compromise mission readiness. The goal is to reduce consumption of aviation fuel by 10 percent by 2015 against an FY2006 baseline.

Currently, the Air Force is implementing a range of energy initiatives that directly align under the Air Force's overarching energy plan. Examples of how the Air Force is reducing demand for energy, increasing supplies of alternative fuels, and changing the culture, in relation to aviation operations, are outlined below.

Reducing Demand within Aviation Operations

Recognizing that aviation fuel is a limited commodity and a mission-critical resource, all Airmen and mission planners must take responsibility for energy management in their area of operations. Fuel optimization will need to be considered throughout all phases of mission planning and execution. By pinpointing areas of Air Force aviation operations that require energy, strategies can be developed to reduce aviation and ground operations fuel demand. For example, by optimizing flight plans and flight routing for fuel efficiency, Airmen can minimize the amount of fuel burned during missions. In-flight procedures such as climb/descent profiles and power settings can also be adjusted for efficient fuel usage.

Efforts to ensure that fuel is burned efficiently include aircraft design improvements, such as:

- Optimized aerodynamics of different aircraft types including radically new aircraft wing and body configurations, such as the blended wing configuration, made possible with the advent of new materials.
- Advancements in materials engineering that use lighter, stronger alloys and composite materials, thereby reducing aircraft structural weight and improving fuel efficiency.
- Advancements in propulsion and engine technologies that use high bypass turbofans, provide dramatic improvements in the amount of thrust generated per gallon of fuel.

- Improvements in mission capabilities have resulted in reductions in fleet size. Stealth technology, advanced avionics, precision-guided munitions, unmanned aerial systems, and other technologies have revolutionized airpower and resulted in fewer, more capable aircraft, accomplishing missions with greater success and survivability.
- Innovative use of flight simulators results in more than just fuel conservation. For example, flight simulators assist in extending airframe life cycles due to less hours flown for training; reduce the number of airframes dedicated for training, which frees aircraft for real-world missions; train Airmen in mission profiles that are not practical to perform in an aircraft; and help Airmen to review, analyze, and debrief performance for a better learning and training experience. Networked simulators allow for accomplishments of formation requirements and synergistic training effects.

As always, Airmen should employ aviation fuel optimization measures without compromising flight safety or jeopardizing mission/training accomplishment.

Increasing Supplies within Aviation Operations

Increasing alternatives and decreasing reliance on foreign oil means that the Air Force will need to engage industry and academia to develop and optimize fuel options that originate within the United States.

The Air Force is pursuing efforts to ensure diversified and domestic sources of energy are utilizable in both ground and aviation operations. One of the most promising developments is alternative jet fuel produced through the Fischer-Tropsch process using coal, natural gas, or biomass. This fuel was flight tested in a B-52 with a synthetic 50/50 blend of JP-8 and alternative fuel. It successfully performed in two engines, in all eight engines, and in cold weather conditions. The B-1, C-5, C-17, F-15, F-22, and T-38 were also tested successfully with the same fuel blend. More tests are on the horizon. Fuel produced through the Fischer-Tropsch



Fuel produced through the Fischer-Tropsch process represents a more environmentally-friendly supply of energy, it has been flight tested in the B-1, B-52, C-5, C-17, F-15, F-22, and T-38.

process represents a more environmentally-friendly supply of energy, as it burns cleaner than petroleum products and produces fewer particulates and no sulfur dioxide.

There is no singular solution to the energy supply issue, but rather a combination of processes and technologies that will move the Air Force and the U.S. toward energy security. These initiatives not only help close the gap in the Air Force's energy budgets, but also provide the best use of taxpayers' resources and ensure an Air Force that is well-equipped and well-positioned to continue its tradition of excellence.

Culture Change

Energy must be part of the operational awareness equation, whereby Airmen across the range of Air Force operations ensure energy is a consideration and a commodity that cannot be wasted.

Changing the Air Force culture is critical to achieving the Air Force's Vision to "Make Energy a Consideration in All We Do." As the culture changes and the Air Force increases its energy awareness, new ideas and methodologies for operating more efficiently will emerge as each Airman considers the energy impact of their day-to-day activities.

The Air Force will challenge all Airmen to implement near-term solutions and operational efficiencies, recognizing that fuel-efficiency optimization occurs at the unit level.

Culture change occurs from within an organization, but external factors can also drive an organization to adjust its culture. Core cultural drivers influencing the formation of an energy management commitment by the Air Force are:

- Energy is increasingly recognized as a critical factor in the Air Force operational equation
- Climate change is a global concern and aviation operations are critical to cutting greenhouse gas emissions
- Energy is a central agenda item on the President's agenda
- Operators are aware of their role in energy consumption
- Airmen understand their role in the overall Air Force Energy Plan
- Energy is a cost born by taxpayers and the Air Force has a responsibility to reduce energy costs
- Principles and guidelines on energy goals need to be aligned with metrics to ensure the Air Force is accurately measuring its impact from instilling energy awareness on an Air Force-wide basis



4 Strategic Approach

The Air Force's overarching energy goals: *Reduce Demand, Increase Supply, and Culture Change*, are supported by the Aviation Operations Energy Plan. These strategic pillars form the foundation for the Aviation Operations Energy Plan and the incorporation of energy considerations across aviation operational areas.

The Aviation Operations Energy Plan is comprised of four "Pillars" that represent areas where energy optimization can occur:

- **Pillar 1**—Provide Leadership in Energy Management
- **Pillar 2**—Fly/Operate Efficiently
- **Pillar 3**—Instill Energy Awareness
- **Pillar 4**—Maximize the Use of Technology for Fuel Efficiency

Within each pillar is a list of objectives and associated metrics that correspond to the pillar framework.

Achieving the Aviation Operations Energy Plan's goals requires supporting objectives and metrics. The goals are supported by the four strategic pillars, which cross-cut through all aspects of aviation operations. Each pillar is important and provides a vital role in meeting the overarching goals. No pillar is more or less important and without executing the objectives under each pillar, it will be difficult to meet our goals.

The strategic pillars emphasize each area that is important for successful aviation operations and will impact energy efficiency as the Air Force pursues its Vision to "Make Energy a Consideration in All We Do."

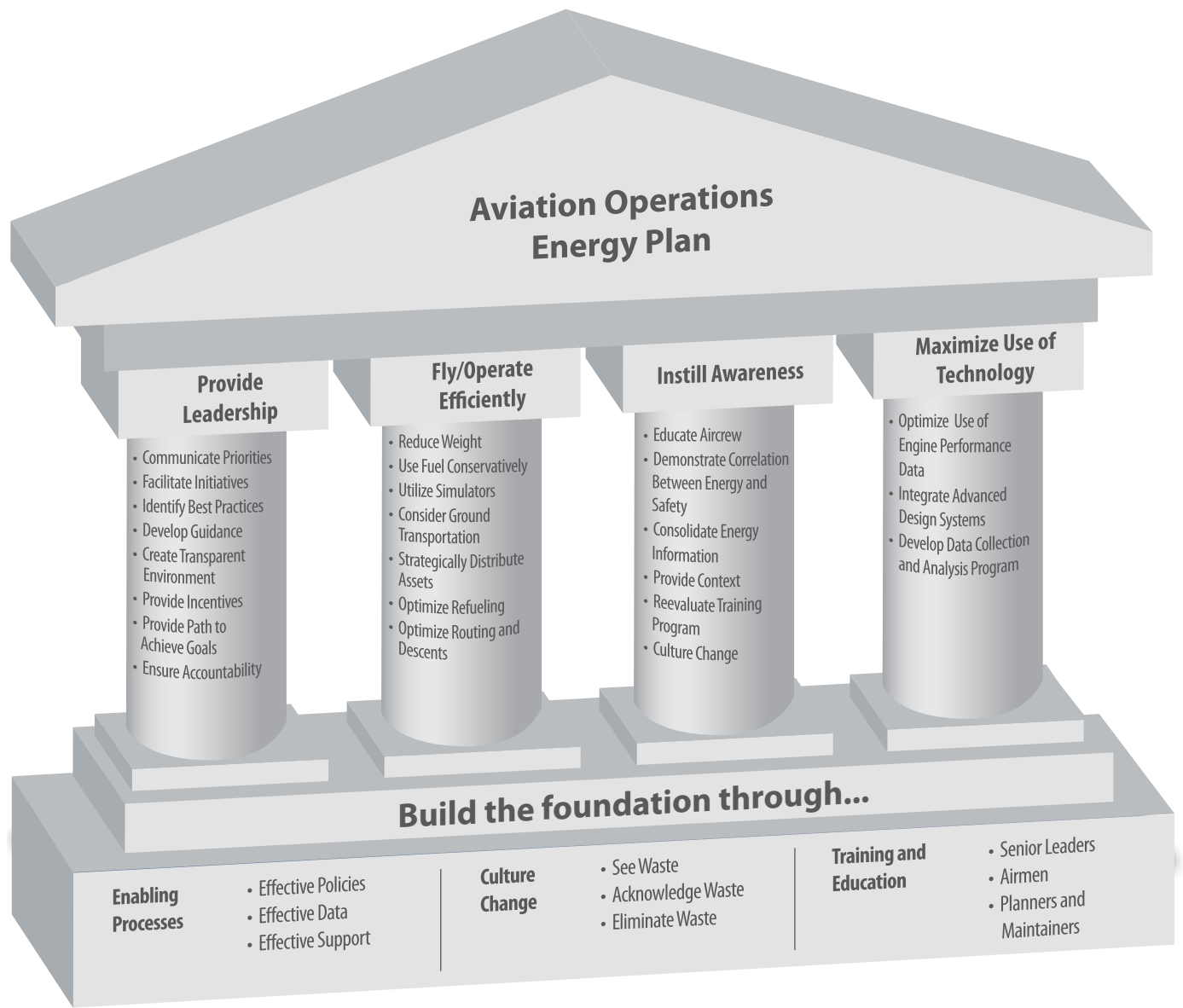
The Air Force has a stellar history of being a leader and expects its commanders to communicate, provide guidance and incentives, and be accountable for increasing energy efficiency in aviation operations. By demonstrating energy efficiency at the top of the chain of command, Airmen and civilians will understand the importance of finding innovative methods and technologies to reduce our energy demand and increase our energy supply.

The second pillar in the Plan focuses on what can be done immediately to increase the Air Force's energy efficiency. The Air Force will examine each area in flying, training, and ground operations to determine where energy improvements can be made.

Instilling Awareness, the third strategic pillar, is all about changing the aviation energy culture. Our leaders will emphasize the importance of energy efficiency and change current aviation practices and habits to use less energy when conducting flying, training, or ground operations.

The final pillar, Maximize the Use of Technology, looks to the future and highlights that the aviation community cannot operate in a vacuum. It must work with acquisition and other communities and disciplines to identify and adopt technological advancements to meet our energy goals.

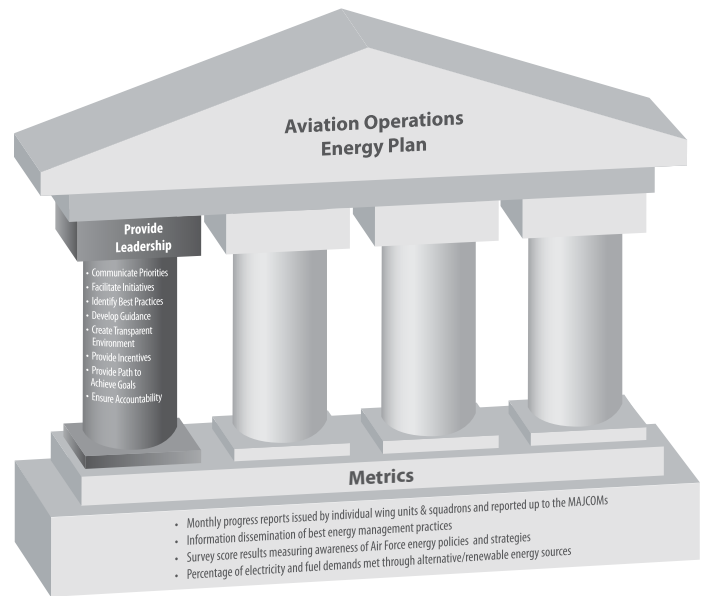
Figure 2 Aviation Operations Energy Plan



Pillar 1: Provide Leadership in Energy Management

Maintaining America’s superior air presence burns a lot of fuel—approximately 2.5 billion gallons of aviation fuel annually—and creates a responsibility that the Air Force takes seriously.

In order to maximize operational energy efficiencies, leadership must provide all Airmen with the tools to execute missions with energy as a consideration. “Pockets of excellence” exist throughout the Air Force’s organizational structure, from the individual guard units to the MAJCOMs; it is incumbent upon Air Force leadership to establish standard operating procedures in energy management for all Airmen to follow. The Air Force aims to foster leadership in each Airman, understanding that many of the best ideas originate from the unit level. Ensuring that energy management information is disseminated on an Air Force-wide basis is contingent upon creating a transparent environment whereby aviation operations energy management procedures are conveyed up and down the chain of command.



Provide Leadership in Energy Management

Objectives

- 1.1 Ensure leadership’s energy priorities are communicated throughout the Air Force
- 1.2 Facilitate renewable energy and energy efficiency initiatives
- 1.3 Identify Air Force energy initiatives and baseline best practices that can be propagated across the Air Force
- 1.4 Develop performance-oriented guidance to drive excellence in energy management
- 1.5 Create transparent environment under which Air Force aviation operations energy reduction procedures are conveyed across the Air Force
- 1.6 Provide incentives for initiating energy efficiency endeavors
- 1.7 Provide proposed path forward for achieving energy objectives
- 1.8 Ensure leadership is accountable for executing energy management strategies

Objective 1.1 Ensure leadership’s energy priorities are communicated throughout the Air Force.

Air Force leadership is committed to making energy a consideration throughout aviation operations. By establishing clear goals and objectives, Air Force leadership will set the energy management framework for all Airmen, understanding that clear and consistent communications about the Air Force Energy Plan is critical if energy management measures are to be executed.

Objective 1.2 Facilitate renewable energy and energy efficiency initiatives.

Air Force leadership supports the development and deployment of renewable energy and energy efficiency initiatives, provided they do not jeopardize mission capabilities and are within budgetary parameters.

Objective 1.3 Identify Air Force energy initiatives and baseline best practices that can be propagated across the Air Force.

Air Force leadership recognizes that many squadrons and units are already initiating energy management practices. The Air Force will promote existing energy best practices and distribute information to help Airmen integrate energy best management practices throughout their operations.

Objective 1.4 Develop performance-oriented guidance to drive excellence in energy management.

Air Force leadership understands the need to provide all Airmen with guidance that can be seamlessly integrated across mission areas. The Air Force will develop and disseminate guidance documents associated with energy management to ensure standard operating procedures are established.



On rugged lave rock terrain these four 225 kW wind turbines are the first phase of a six turbine site of the 45th Operations Group, Detachment 2, at Ascension Auxiliary Airfield, South Atlantic Ocean. They help power the nearby facility, the TAA-3C-1 and TAA-3C-2 telemetry systems on South Gannett Hill. The wind turbines work in parallel with low-load diesel generators powering the airfield, Space Command sites and facilities, and an airfield facility.

Objective 1.5 Create a transparent environment under which Air Force aviation operations energy reduction procedures are conveyed across the Air Force.

Air Force leadership recognizes it must take an integrated approach to energy management. Ensuring that energy management information is readily accessible across the Air Force will be critical for the implementation of Air Force energy management strategies. Leadership will ensure that energy management efforts are coordinated and communicated throughout the Air Force.

Objective 1.6 Provide incentives for initiating energy efficiency endeavors.

Recognition of energy management best practices will provide the incentive structure necessary to ensure the propagation of energy-saving initiatives across the Air Force. Establishing an incentive structure within the Air Force to reward effective energy management procedures signals to all Air Force personnel how important energy management is to leadership.

Objective 1.7 Provide proposed path forward for achieving energy objectives.

Though energy is a critical part of Air Force operations, energy management is not a mission; rather it is part of an overall equation associated with Air Force operational capabilities. Leadership needs to continue to provide the context as to why

energy management is important to not only the Air Force, but to national security, and propose a path forward for all Airmen to integrate energy management into their standard operating procedures.

Objective 1.8 Ensure leadership is accountable for executing energy management strategies.

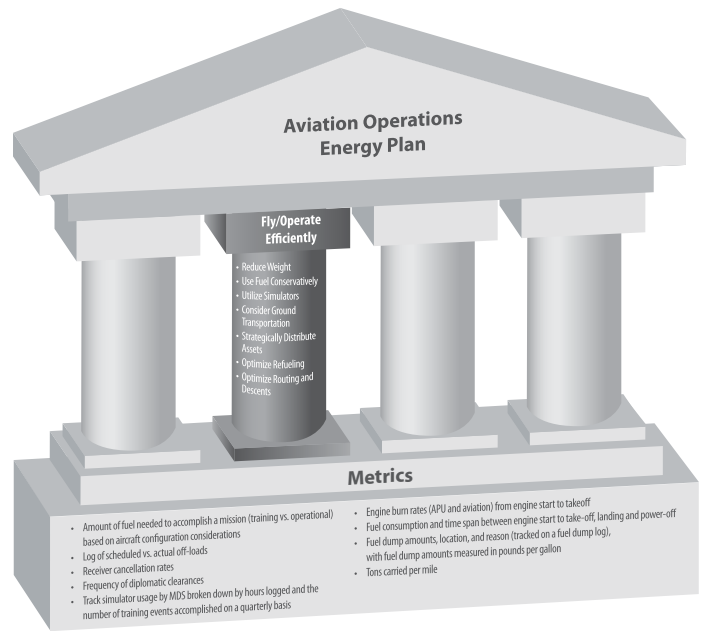
Accountability is a key component of the Air Force culture. In order to ensure sustained efforts around energy management, leadership will be responsible for not only providing the framework for energy management across the Air Force, but also for making sure that energy management practices are actually implemented on the ground and in the air.

Provide Leadership in Energy Management

Metrics
<ul style="list-style-type: none"> ■ Monthly progress reports issued by individual wing units & squadrons and reported up to the MAJCOMs ■ Information dissemination of best energy management practices ■ Survey score results measuring awareness of Air Force energy policies and strategies ■ Percentage of electricity and fuel demands met through alternative/renewable energy sources

Pillar 2: Fly and Operate Efficiently

This pillar focuses on optimizing energy usage across aircraft and ground operations. Aviation operations involve multiple decision-points that influence energy consumption rates. For example, even though different aircraft engines have standard burn rates based on aircraft engine types, there are techniques that the individual Airman can employ while operating the aircraft, which can result in the reduction of fuel consumption. Fuel load configurations impact the amount of drag placed on an aircraft, the more fuel an aircraft carries results in more energy burned. Pre-flight checklists can help Airmen determine the fuel load requirements of a mission. Fuel load configurations not only influence fuel consumption reductions, but also minimize fuel dumping. For safety reasons, Airmen do not want to land an aircraft with significant amounts of fuel still on-board. Thus, making sure that fuel loads are configured for a mission can reduce fuel dump rates and save energy and financial resources.



Fly and Operate Efficiently

Objectives

- 2.1 Revisit drag and weight reduction possibilities
- 2.2 Optimize fuel loads for each mission
- 2.3 Use simulator capability to the maximum extent possible when fidelity permits training sortie substitution
- 2.4 Increase the use of alternatively-powered ground equipment/vehicles
- 2.5 Ensure assets are properly positioned
- 2.6 Optimize air refueling
- 2.7 Optimize routing and profile descents

Objective 2.1 Revisit drag and weight reduction possibilities.

Aircraft configuration is important in realizing energy-savings during aviation operations. Aircraft burn rates directly correlate to the amount of weight carried by an aircraft per mile traveled. Weight reduction optimization during pre-flight planning can assist the Air Force in reducing energy consumption.

Objective 2.2 Optimize fuel loads for each mission.

Fuel loads should be optimized by determining the fuel required for mission execution during the flight planning phases. Optimizing fuel loads on aircraft can reduce fuel dump frequencies and represent a significant potential for fuel conservation. Review current ramp loads to identify fuel optimization opportunities. Ramp fuel and recovery fuel should be tailored to reduce aircraft gross weight within the parameters of safe mission accomplishments and training requirements.

Objective 2.3 Use simulator capability to the maximum extent possible when fidelity permits training sortie substitution.

The emergence of high fidelity simulators is enhancing the Air Force's training capabilities by allowing sorties to train in a range of mission

scenarios. Using simulators for training also reduces fuel use for training exercises. Quality simulation can often provide higher-quality training than training that is routinely available in an aircraft due to landscape constraints, air space restrictions, and other limitations. The Air Force should optimize and implement the use of high fidelity simulators for appropriate training requirements. Additionally, the Air Force should identify factors that limit or prohibit moving additional training from aircraft to simulators.

Objective 2.4 Increase the use of alternatively-powered ground equipment/vehicles.

Flex-fuel vehicles have engines that are compatible with E-85 (ethanol) and petroleum. The Air Force should increase the use of alternative fuel vehicles for conducting ground operations, including vehicles powered by liquefied natural gas, biodiesel, and ethanol.

Objective 2.5 Ensure assets are properly positioned.

Transporting equipment is an energy-intensive process. Ensuring that equipment and aircraft are located in regions where Air Force operations are anticipated or ongoing would enhance the response capabilities of the Air Force while simultaneously reducing the amount of energy used to transport mission-critical equipment across large geographical areas.

Objective 2.6 Optimize air refueling.

Air refueling operations require precise coordination between the aircraft being refueled and the aircraft conducting refueling operations. The Air Force should review C2 and flight following procedures to ensure tanker/receiver cancellations are passed to affected aircraft expeditiously upon change of status. Ensuring that fuel requirements are properly assessed during aviation operations will enhance fuel planning and could result in fuel savings. The Air Force should consider en route fuel stops as an alternative to in-flight refueling. A Fully Burdened Cost of Fuel Study conducted by the Air Force show the cost per gallon of fuel delivered via in-flight refueling is significantly more expensive than fuel delivered via ground refueling. Understanding that combat operations greatly impair the ability of aircraft to be refueled on the ground, Air Force should nonetheless consider secure and efficient refueling options in its operations.

Objective 2.7 Optimize routing and profile descents.

The Air Force should review mission planning and aircraft routing procedures from a fuel efficiency perspective. The Air Force should implement procedures to capture potential fuel efficiencies, such as more direct routing or shorter dip cleared routing.

Fly and Operate Efficiently

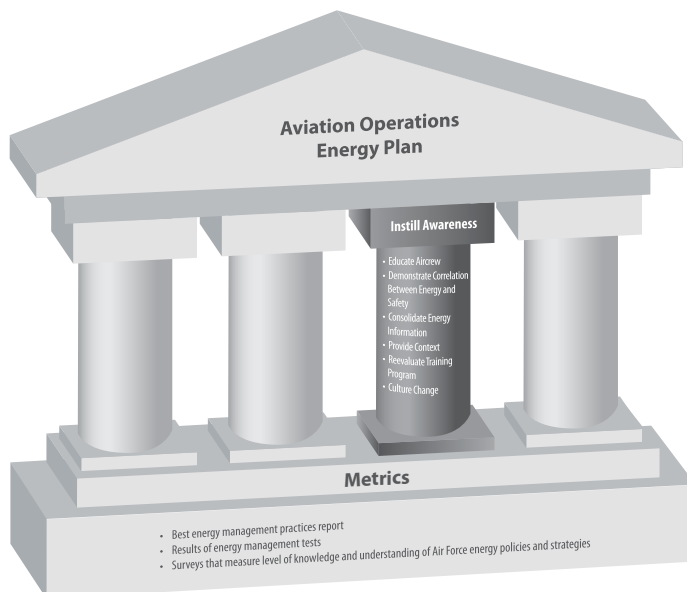
Metrics
■ Amount of fuel needed to accomplish a mission (training vs. operational) based on aircraft configuration considerations
■ Log of scheduled vs. actual off-loads
■ Receiver cancellation rates
■ Track simulator usage by MDS broken down by hours logged and the number of training events accomplished on a quarterly basis
■ Engine burn rates (APU and aviation) from engine start to take-off
■ Fuel consumption and time span between engine start to take-off, landing, and power-off
■ Fuel dump amounts, location, and reason (tracked on a fuel dump log), with fuel dump amounts measured in pounds per gallon
■ Tons carried per mile



The HydraFLX System is brought up to the back end of a C-17 Globemaster III to demonstrate its mobile capability at Hickam Air Force Base, Hawaii. The Air Force is testing the HydraFLX System as an alternate energy source. It will generate ultra-pure H2 (hydrogen) from water in a flexible pressure management process for fueling buses, tow-tractors, vans, sedans, and ground support equipment. The system can also be deployed anywhere and operate in hostile theaters without infrastructure or pipelines.

Pillar 3: Instill Energy Awareness Across Aviation Operations

This pillar focuses on culture change within the aviation community. Identifying energy efficiency practices will not achieve our energy goals unless we implement these practices into our flying operations as habits. Instilling awareness will require changes in training methodologies, and commanders will need to champion energy efficiency practices throughout their organizations. Impacting change will require the use of multimedia solutions and campaigns where the Vision to “Make Energy a Consideration in All We Do” becomes second nature. We expect that many of our energy efficiencies will come from the Airmen and civilians working aviation operations, so communication channels will need to flow in both directions from top leaders to recruits and from recruits to top leaders. By working together, aviation culture change can occur.



Instill Energy Awareness

Objectives

- 3.1 Educate, evaluate, and create incentives for fuel conservation during aviation operations
- 3.2 Establish a comprehensive view of how energy and safety issues intersect
- 3.3 Consolidate energy information documents to create a cohesive framework of Air Force energy management
- 3.4 Provide the context as to why aviation operations are important to energy issues
- 3.5 Reevaluate training program to ensure it is reflective of energy goals and operational situational considerations
- 3.6 Instill a culture where every Airman works to fly more efficiently

Objective 3.1 Educate, evaluate, and create incentives for fuel conservation during aviation operations.

Education is essential in establishing energy awareness across the Air Force. The Air Force is committed to creating a culture where Airmen understand the importance of energy management and are encouraged to execute energy-saving strategies when possible.

Objective 3.2 Establish a comprehensive view of how energy and safety issues intersect.

Airmen are specifically trained to mitigate against any safety hazards on the ground and in the air. Aircraft landing weight configuration considerations serve multiple purposes, including safety, aircraft wear and maintenance. Proper pre-flight planning, whereby an aircraft is filled with the appropriate amount of fuel for a mission, can help reduce the frequency of fuel dumps and the risk to pilots of landing with more fuel on board than is needed.

Objective 3.3 Consolidate energy information documents to create a cohesive framework of Air Force energy management.

Information on Air Force energy management initiatives and guidance forms the foundation for establishing an energy-conscious community

throughout the Air Force. As the Air Force continues to develop energy management strategies, information consolidation and distribution mechanisms will need to be incorporated to ensure that all energy-related information is readily available for all Airmen in a centralized manner.



A U.S. Air Force F-16 Fighting Falcon from the 56th Fighter Wing moves into position to receive fuel from a KC-135R Stratotanker from the 336th Air Refueling Squadron (ARS) during an aerial refueling training mission.

Objective 3.4 Provide the context as to why aviation operations are important to energy issues.

Establishing the context as to why Airmen should make energy a consideration of aviation operations will be critical if the Air Force is to sustain its energy management strategies. Once Airmen understand how energy impacts mission capabilities, Air Force initiatives will more effectively resonate throughout the aviation community.

Objective 3.5 Reevaluate training program to ensure it is reflective of energy goals and operational situational considerations.

Air Force training programs are some of the best in the world. Ensuring that all Airmen have the skill sets required to not only operate different types of aircraft, but also accomplish mission execution under various scenarios is vital for the Air Force to maintain air dominance throughout the world. Advances in simulator technologies are providing new training platforms for Airmen, which can allow for flight training programs to be configured in a manner that optimizes mission-training potential while reducing training fuel consumption.

Objective 3.6 Instill a culture where every Airman works to fly more efficiently.

How an Airman operates an aircraft both on the ground and in the air directly influences fuel burn rates. Reducing taxi time and minimizing the use of auxiliary power units can decrease the amount of fuel consumed during aircraft operations.



Maintenance crews keep fleet flying. 392nd Air Expeditionary Wing aircraft maintenance personnel inspect and refuel an A-10 Thunderbolt II aircraft at a forward-deployed location in Southern Iraq in support of Operation Iraqi Freedom.

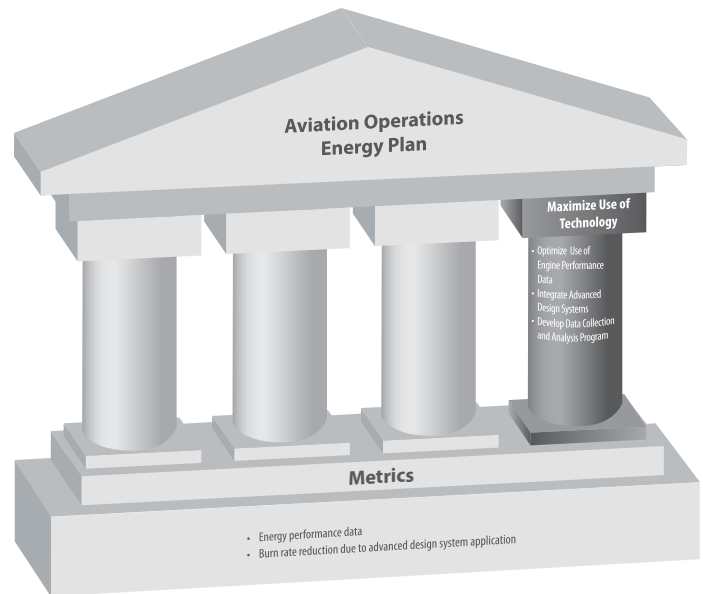
Instill Energy Awareness

Metrics

- Best energy management practices report
- Results of energy management tests
- Surveys that measure level of knowledge and understanding of Air Force energy policies and strategies

Pillar 4: Maximize the Use of Technology for Fuel Efficiency

This pillar focuses on the application of technology in aircraft and ground operations equipment. The Air Force mission requires range and persistence in aircraft. To accomplish this, the Air Force must reduce fuel costs and explore technological solutions to increase fuel efficiency. The Air Force is continuously conducting aircraft and engine fuel efficiency research, alternative fuel certification, Next Generation navigational equipment, and vehicle drag reduction. As new technologies come online, operations and training procedures need to be reevaluated to maximize the impact of technology in energy management. As simulators improve, more training missions can be conducted through simulation exercises, saving energy and reducing wear on aircraft.



Technology Maximization

Objectives

- 4.1 Optimize use of engine performance (and related) data to manage aircraft fleet performance in achieving fuel efficiency goals
- 4.2 Integrate Advanced Design Systems for aviation operation energy efficiencies
- 4.3 Develop technologies to enable command-level data collection and analysis

Objective 4.1 Optimize use of engine performance (and related) data to manage aircraft fleet performance in achieving fuel efficiency goals.

Data collection software and analysis programs can enhance the Air Force's energy management capabilities by providing a systematic way to measure fuel efficiency in aviation operations. Cost-savings measurements should be integrated into energy management software to provide the financial data necessary to illustrate how energy efficiency programs are saving the Air Force money.

Objective 4.2 Integrate Advanced Design Systems for aviation operation energy efficiencies.

Advanced Design Systems, such as Geographic Information Systems and Mode S transponders, provide Airmen with real-time information that can be used to adjust aircraft speed, turn radius, and descent profiles, all of which influence energy consumption rates.

Objective 4.3 Develop technologies to enable command-level data collection.

Metrics are critical to evaluate the Air Force's progress with respect to energy management. Applying or acquiring technology to record data is more reliable and cost effective than manual inputs, and allows for a streamlined data management process to be utilized for energy management purposes. Technical information will help educate Airmen and establish a comprehensive view of how energy is an integral part of Air Force operations.

Technology Maximization

Metrics

- Energy performance data
- Burn rate reduction due to advanced design system application



Capt Joseph Babboni trains on a B-52 Stratofortress simulator at Barksdale Air Force Base, Louisiana to improve his proficiency at air refueling. An actual flight in a B-52 bomber costs approximately \$16,000 per hour. The flight simulator costs approximately \$400 per hour to operate. Despite the cost savings, not all training can be conducted in a simulator. Capt Babboni is a pilot with the 11th Bomb Squadron. (U.S. Air Force photo/Lance Cheung)

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5 Governance Structure

Energy Focus Group

Energy Management Steering Groups (EMSGs) provide the focal point for energy-related matters at the organizational level (HAF, MAJCOM, or installation). Additionally, EMSGs are responsible for coordinating all energy matters within the applicable level of command. The Energy Senior Focus Group (SFG) serves as the EMSG within HAF. The Energy SFG, with its working groups, constitutes the senior governance structure for energy matters in the Air Force and acts as a coordinating body for cross-functional issues. AF/A3/5 leads the Aviation Energy Program, which includes the Aviation Operations Energy Plan. AF/A3/5 serves as a member of the Energy SFG and chairs the Aviation Operations Working Group (AOWG). The Air Force Operations Group (AF/A3O-AH) chairs the Critical Infrastructure Program (CIP) Advisory Working Group. The governance structure for the Energy SFG and the role of AF/A3/5 within the Energy SFG is presented in Figure 3 on the next page.

Aviation Operations Working Group

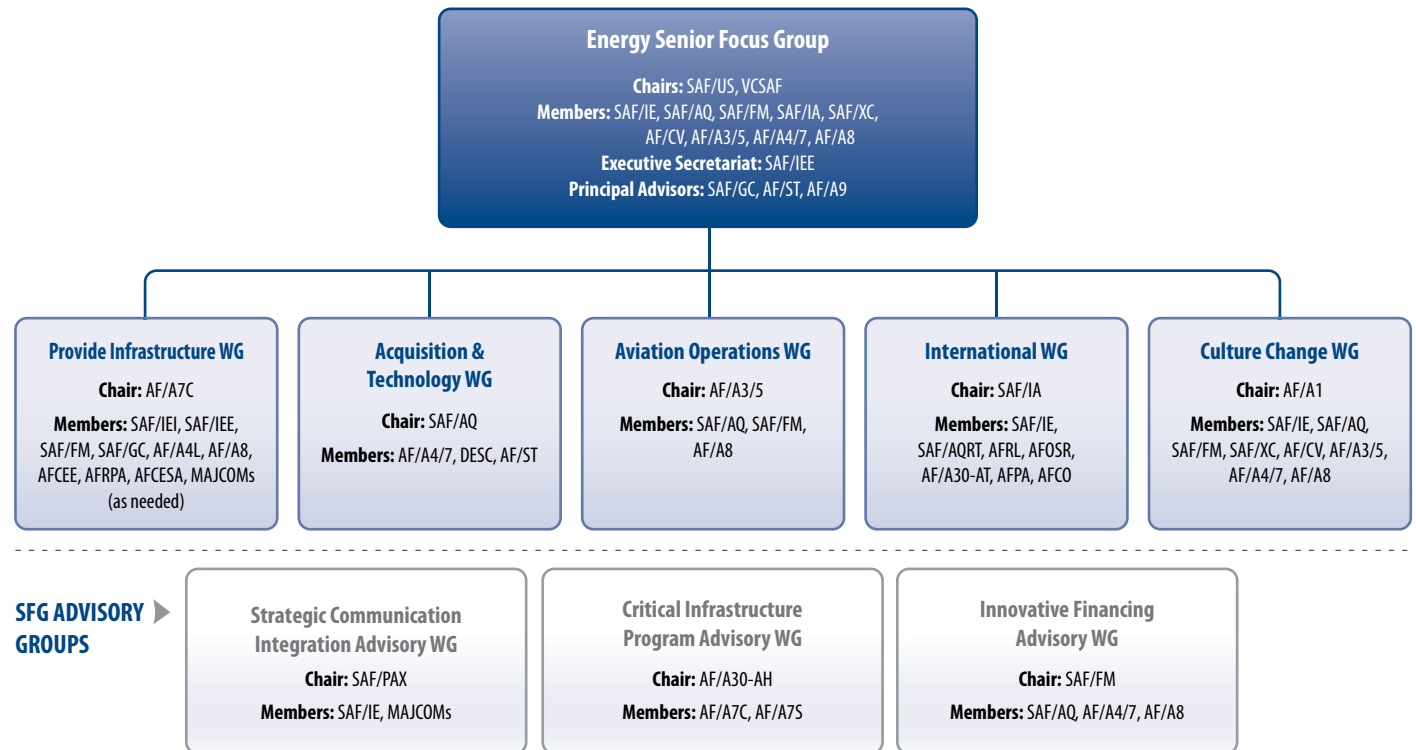
The AOWG coordinates energy management enhancement efforts as they pertain to the logistical and operational aspects of aviation operations. AOWG ensures aviation operational effectiveness by validating all mission and training requirements, migrating flying training to Aircrew Training Devices when practical, and developing a fuel conservation culture within the aviation operations community. The overarching goals of the AOWG are to ensure the

Air Force maintains the ability to conduct effective operations as required to protect the nation and secure its vital interests by eliminating training for capabilities no longer required, determining the right mix of live-fly and high-fidelity simulation, and incorporating energy as a consideration in aviation operations. The AOWG is responsible for formulating goals, objectives, and metrics associated with integrating energy considerations into Air Force aviation operations. Major activities designed to enhance energy management across the aviation operations community include:

- Creating a fuel conservation culture
- Validating mission and training requirements
- Migrating flight training to high-fidelity simulators, when feasible
- Optimizing air refueling operations
- Improving ground operations through fuel efficiency
- Applying demand-side fuel accountability strategies across air and ground operations
- Exploring the application of a standardized fuel planning process to rectify disparities between planned and carried fuel loads
- Developing Aircrew checklists to minimize taxi-to-shutdown time and save energy
- Applying direct routing to flight planning
- Considering aircraft configuration in achieving energy savings

The AOWG recognizes that there is increasing interest by senior leadership in demand- and supply-side energy considerations. The potential cost-savings associated with energy conservation are real, especially with respect to fuel cost volatility. Technological advances provide opportunities for the deployment of energy management mechanisms across the Air Force. Aviation operations account for the largest proportion of the Air Force's energy usage profile, and thus the AOWG is committed to ensuring the goals, objectives, and metrics associated with the Air Force Energy Plan and Aviation Operations Energy Plan are met without delay.

Figure 3 Governance Structure of the Air Force Senior Focus Group





6 Conclusion

Across all Air Force mission areas, energy is the common denominator. Energy is a mission-critical component of aviation operations and is essential to sustain mission readiness and responsiveness on a global basis. Increasing global demand and uncertainty of dependable energy supplies highlights why energy security represents a national security issue. As the largest consumer of fuel in DoD, the Air Force must ensure that it optimizes aviation energy efficiencies and conservation initiatives.

The Air Force is committed to its Aviation Energy Plan. Creating and maintaining a strong aviation energy strategy today means ensuring a superior air presence tomorrow. To decrease reliance on foreign oil and to ensure an energy-conscious environment, the aviation community supports the Air Force Energy Plan goals of Reduce Demand, Increase Supply, and Culture Change by integrating demand-side energy efficiency measures with a long-term commitment to supply-side alternative energy sources. These measures are reinforced by a program of culture change within the aviation community.

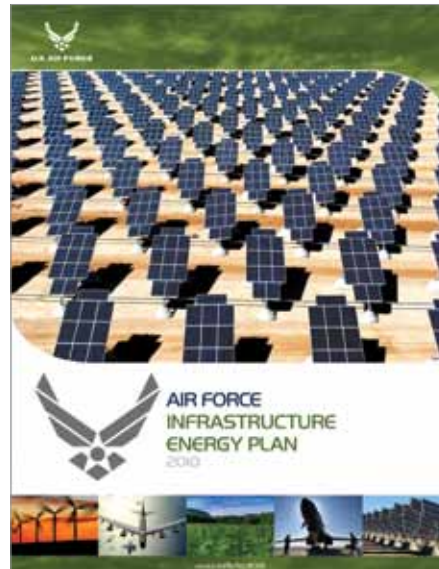
The Aviation Operations Energy Plan is comprised of four “Pillars” that cross-cut all areas of the aviation community. These Pillars are:

- **Pillar 1**—Provide Leadership in Energy Management
- **Pillar 2**—Fly/Operate Efficiently
- **Pillar 3**—Instill Energy Awareness
- **Pillar 4**—Maximize the Use of Technology for Fuel Efficiency

Each of these pillars provides the guidance for current and future aviation energy initiatives to achieve the Air Force energy goals. The first pillar focuses on how our leadership is providing support and guidance to the aviation community. The second pillar demonstrates our commitment to modify current operational practices to increase energy efficiency without compromising mission readiness. The third pillar shows our commitment to the Air Force Energy Vision to “Make Energy A Consideration in All We Do.” The fourth pillar looks to the future as the Air Force designs and modifies new air frames to be more energy efficient and applies advanced technologies across platforms. We are committed to executing our Aviation Energy Plan and supporting the achievement of the Air Force energy goals.

Aviation operations involve a complex set of energy inputs and outputs. From pre-flight planning (*e.g.*, fuel loading, weight configurations, routing) to in-air operations, energy usage rates are a direct function of how the Air Force operates its aircraft. The Aviation Operations Energy Plan sets the foundation for Airmen to incorporate energy considerations throughout their areas of influence, setting the stage for a culture change toward a more energy efficient Air Force.

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