



U.S. AIR FORCE

# Energy Flight Plan

2017 – 2036

Enhancing Mission Assurance through Energy Assurance



# Forward

January 6, 2017

**E**nergy availability and resiliency impacts all Air Force missions, from installation infrastructure to aviation operations, at both enduring and non-enduring locations. In order to maintain the Air Force's critical airpower contributions to national security, significant amounts of energy are required. Accordingly, the Air Force has developed a comprehensive approach to energy management to improve its ability to manage supply and demand in a way that enhances both mission capability and readiness.

The Air Force Energy Flight Plan reflects the Department's emphasis on operational energy and energy resiliency while reframing the Air Force's approach to energy through three goals: *Improve Resiliency, Optimize Demand, and Assure Supply*. By aligning the strategic energy goals and objectives with the Air Force's Strategic Master Plan, the Air Force is positioned for the continuous evolution required of a developing, cross-cutting focus area. This improved alignment helps set the stage for the Air Force to meet federal energy legislative provisions, Executive Orders, and DoD directives.

The goals and objectives outlined in this Flight Plan define what success means to the Air Force in the context of the Strategic Master Plan. This plan does not necessitate temporarily suspending flights nor reducing installation and equipment operation simply to save fuel and electricity. Instead, it is intended to increase combat capabilities and mitigate energy risks to the Air Force's global mission.

To continue sustaining and enhancing its capabilities, particularly in an era of increasing fiscal constraint, the Air Force must diligently manage its resources. The Air Force's priority is to make informed decisions and take appropriate actions to ensure it continues to achieve critical missions that provide *Global Vigilance, Global Reach, and Global Power*. By developing a robust, resilient, and ready energy posture, the Air Force will enable its warfighters; expand its operational effectiveness in air, space, and cyberspace; and provide mission assurance through energy assurance.



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The term “**agility**” is meant to capture the attributes of flexibility, adaptability, and responsiveness. “**Inclusiveness**” is about harnessing every possible resource to ensure we are delivering the world’s most powerful Air Force.

– Air Force 30-Year Strategy

# Executive Summary

The United States Air Force's mission is to fly, fight and win in air, space and cyberspace. To achieve this mission and protect the Nation's interests, the Air Force requires ready Airmen, robust weapon systems, and resilient infrastructure—all of which require energy to operate.

The Air Force Energy Flight Plan is a comprehensive document that aligns with *America's Air Force: A Call to the Future*, the Air Force's 30-Year Strategy, and its Strategic Master Plan. This Flight Plan provides a framework for coordinating activities across multiple organizations and engaging thousands of individuals to enhance mission assurance through energy assurance across the United States Air Force. Two keys to providing energy assurance are agility and inclusivity, which enables the Air Force to adapt swiftly to any situation or enemy action and to address the energy challenges posing a threat to its operations. By making our power systems more resilient, we increase deterrence and deny potential enemies the ability to achieve intended objectives.

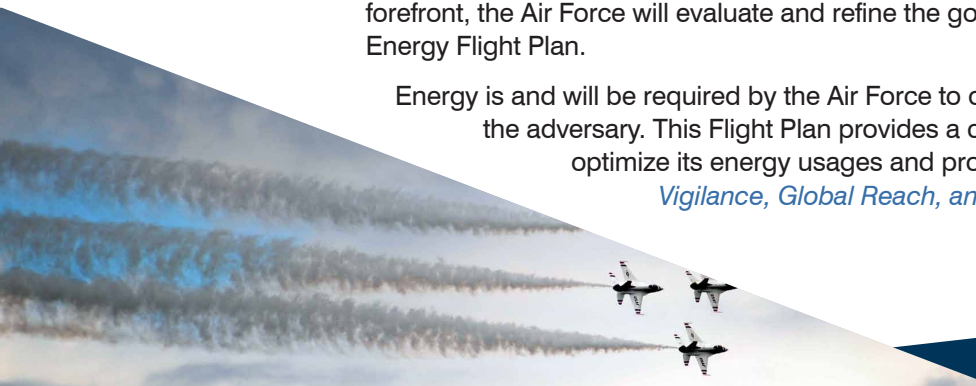
Energy assurance involves a vast array of activities across the operational and installation spectrums designed to ensure the Air Force has the energy when and where it is needed to ensure it can accomplish its mission. Energy also provides a key advantage over the Nation's adversaries. By optimizing its demand and using its resources efficiently and productively, the Air Force will be able to increase its mission capabilities. This leads to the Air Force's Energy Vision to *Enhance Mission Assurance Through Energy Assurance*.

The three goals communicated in this document—*Improve Resiliency, Optimize Demand, and Assure Supply*—are designed to move the Air Force toward improving energy assurance, enhancing energy security, and overcoming the challenges posed by the vulnerabilities created by its energy requirements. In supporting the Air Force's energy vision, these three goals provide the basis for achieving the strategic outcomes today and in the future.

Underneath each goal, this Flight Plan articulates objectives that provide specific and measureable actions that will move the Air Force toward achieving that goal. The Flight Plan also provides a brief discussion on the technological, behavioral, and systemic tools in place to assist with achieving its energy goals.

As stated in *America's Air Force: A Call to the Future*, one of the most important responsibilities of a military service is to prepare the force for the challenges of tomorrow, not just the realities of today. As new technologies and methodologies come to the forefront, the Air Force will evaluate and refine the goals and objectives identified in this Energy Flight Plan.

Energy is and will be required by the Air Force to operate, regardless of the location or the adversary. This Flight Plan provides a clear path forward for the Air Force to optimize its energy usages and provide effective and responsive *Global Vigilance, Global Reach, and Global Power* for America.





# Introduction

## Energy is a strategic imperative for the Air Force mission

The United States Air Force's mission is to fly, fight and win in air, space and cyberspace. This mission requires advanced weapon systems, highly sophisticated equipment, and the best trained Airmen in the world. The Air Force plays a vital role in protecting and preserving the Nation's security interests, and it helps the country maintain *Global Vigilance, Global Reach, and Global Power*. Every military capability, mission, and member of the Air Force depends on a reliable supply of energy.

Energy is critical for the U.S. military's core national defense mission, yet it is simultaneously a vulnerability to the military's ability to confront 21st century challenges that are global and increasingly more complex. This "double-edged sword" is precisely why energy security is a core element of many of the national strategic policies and plans, such as the National Security Strategy, the National Military Strategy, and the Quadrennial Defense Review (QDR). Current concepts of operations require more energy—including fuel and electricity—and have strategic and operational risks and potential adverse consequences not faced by previous generations.

Transforming the way the Air Force uses energy—including investing in innovation and building an energy-secure force—is critical to ensuring it is equipped to sustain the mission priorities of today while planning for the challenges of the future. The Air Force recognizes that there are many national energy policy challenges, to include tackling the economic impacts of energy costs and mitigating the national security implications of climate change. While addressing these challenges is crucial, having the energy necessary to accomplish its mission takes primacy for the Air Force.

Accordingly, the Air Force is improving its ability to manage energy supply and demand in a way that enhances mission

### ENERGY SECURITY DEFINITION

The term "energy security" means having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs.

– 10 U.S.C. 2924

capability and readiness while helping address the Nation's broader energy challenges. The Air Force, however, cannot address energy security alone. It must integrate its efforts, not only within DoD, but also with local, regional, state, federal, and international partners.

The Air Force must be agile and inclusive to address the energy challenges posing a threat to its operations. By recognizing and quickly adopting initiatives to increase mission capability through maximizing the output from each watt consumed or gallon burned (i.e., energy productivity), the Air Force can continue to achieve and sustain its mission. One way this can be accomplished is through active partnerships and discussions, both from within the Air Force as well as outside to include partner nations and industry.

### A Vision for the Future

Energy is a necessity for all Air Force missions and operations, and the Air Force recognizes energy as an integral part of its systems and not simply as a commodity. This perspective and the need to be agile and inclusive leads to the Air Force Energy Vision to *Enhance Mission Assurance Through Energy Assurance*. By making the best use of its energy resources, the Air Force achieves an edge toward ensuring operational supremacy.



## The Air Force Energy Vision: Enhance Mission Assurance Through Energy Assurance

To meet its long-term energy vision, the Air Force must maintain a clear picture of how energy affects the Air Force's critical capabilities and requirements. As it strives to achieve its vision, the Air Force is integrating energy considerations across the enterprise by focusing on three strategic goals: *Improve Resiliency, Optimize Demand, and Assure Supply* (Figure 1). These goals provide the overarching framework through which the Air Force will address every dimension of the energy challenge it faces, from security to supply and demand, as well as fostering a culture that values energy as a strategic resource.

The Air Force approaches these goals through innovation and advanced technology. Innovation comes from all involved in its enterprise. By adopting the ideas of Airmen, as well as allies and industry, the Air Force can expand its ability to address its energy challenges. The Air Force is also integrating technological advances to improve energy resiliency and taking full advantage of the opportunities those advances afford.

From aircraft and ground vehicle refueling requirements to satellite control and information dissemination capabilities, the Air Force must address the role of energy and the systems that support energy distribution. This approach will

enable the Air Force to understand the implications of energy utilization across all operational domains, to build the foundation for enhancing energy security, and to instill energy management best practices through the development of an energy-aware culture. It is essential the Air Force consider the impacts energy can have on its capabilities and on its ability to assure the mission in future planning efforts. By improving the efficiency of its processes, operations, facilities, and equipment, the Air Force will increase its effectiveness and generate cost savings.

Energy consumption has a direct impact on greenhouse gas emissions, which has been attributed as a factor to climate change. As described in the 2014 QDR, climate change has the potential to significantly impact future Air Force actions—from the environments where it operates to the missions it undertakes and where facilities can be located. By optimizing its energy demand and increasing its use of clean energy, the Air Force can improve its energy resiliency and reduce greenhouse gas emissions in support of U.S. climate policy initiatives.

### Air Force Strategic Energy Goals:

- Improve Resiliency
- Optimize Demand
- Assure Supply

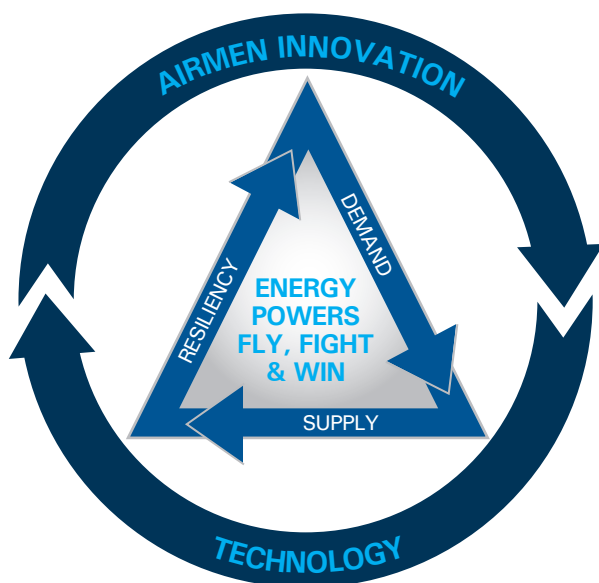


Figure 1: Air Force Approach to Energy

This document communicates the Air Force's approach to energy and presents a formal structure to maintain an enterprise-wide approach and to provide global oversight to solve the complex energy challenges facing the Air Force. It also identifies the strategic energy thrusts, which all Airmen can utilize to make energy a part of operational considerations. From developing new energy options that provide secure and reliable energy alternatives to pursuing energy efficiency and conservation initiatives, the Air Force is making great strides in cultivating a culture within the Air Force that values energy as a mission-critical resource and that continues to evolve into a more sustainable force to fly, fight, and win.

## Air Force Energy Classification

In order to better address the energy challenges it faces, the Air Force broadly categorizes its energy consumption into “operational energy” and “installation energy,” which enables the Air Force to more easily identify areas of concern and to develop appropriate investment strategies. Operational energy assets are dependent on an installation to serve as a platform from which to launch, operate, and recover, as well as for servicing and maintaining air, space, and cyber assets. The two are inextricably linked and only through the optimization of energy delivery and use can the Air Force perform at the pinnacle of its capabilities.

### Operational Energy

The Air Force’s primary concern is supporting current operations and protecting the Nation. This requires having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs. The Air Force characterizes operational energy, which is defined under 10 USC §2924, as the energy used by the Air Force that has a direct and immediate impact to missions. While this is predominantly aviation fuel, there are major mission energy requirements at its installations, where the denial or loss of energy can have tactical, operational, and strategic consequences.

#### OPERATIONAL ENERGY DEFINITION

The term “operational energy” means the energy required for training, moving, and sustaining military forces and weapons platforms for military operations. The term includes energy used by tactical power systems and generators and weapons platforms.

– 10 U.S.C. 2924

### Installation Energy

In order to ensure it has reliable and resilient platforms from which to operate, the Air Force needs its bases to be designed and operated in a way that ensures they are ready for any man-made or natural disruption to the supply of energy, water, or other utilities. For the Air Force, installation energy is the energy used by facilities and non-tactical ground vehicles in support of air, space, and cyberspace missions. While this is primarily the electricity used to power its facilities, it also includes natural gas and fuel for vehicles that contribute to mission support tasks. The electricity, heat, and fuel used to power Air Force facilities, its industrial processes, and its ground vehicles all fall under the Air Force installation energy umbrella.

#### INSTALLATION ENERGY DEFINITION

The term “installation energy” means the energy used to power all facilities located on military installations and enduring locations, as well as fuel for the non-tactical fleet vehicles used at those locations and the energy consumed in manufacturing, maintenance, and other processes.



# The Air Force Energy Strategic Landscape

A strong energy posture enables warfighters, expands operational effectiveness, and enhances national security

Energy is essential to all five core missions of the United States Air Force—air and space superiority; intelligence, surveillance, and reconnaissance (ISR); rapid global mobility; global strike; and command and control. Achieving excellence across these missions requires significant amounts of energy, a vital resource that enables the operational capabilities required by Airmen to *fly, fight, and win*. Air Force energy demand is ever present for fueling its training, force sustainment, humanitarian relief efforts, intelligence gathering, and combat operations.

## Current State

Energy is a constraining resource requiring long logistics tails that affects how the Air Force engages across the full spectrum of operations. As a result, energy represents a critical vulnerability for both the Nation and the military.

To put Air Force energy use in perspective, it is important to understand how much energy the Air Force consumes in relation to the DoD. The Air Force alone typically accounts for just under 50 percent of the total DoD energy consumption and costs, with the vast majority of this spent on aviation fuel (Figure 2).

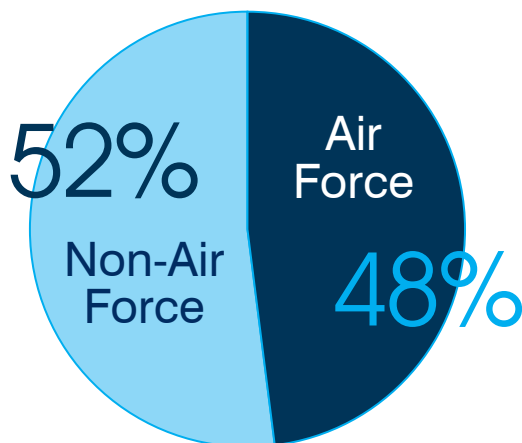


Figure 2: Breakdown of DoD Energy Consumption

This equates to approximately two billion gallons of aviation fuel and 64 trillion BTUs each year, as well as significant amounts of greenhouse gas emissions—35 million metric tons of carbon dioxide (CO<sub>2</sub>) equivalent. Yearly energy costs for the Air Force are upwards of \$8 billion, with about 86 percent of those costs spent on aviation fuel (Figure 3). Since 2003, energy has represented a larger share of an overall Air Force budget increasing from three percent in 2003 to eight percent in 2015.

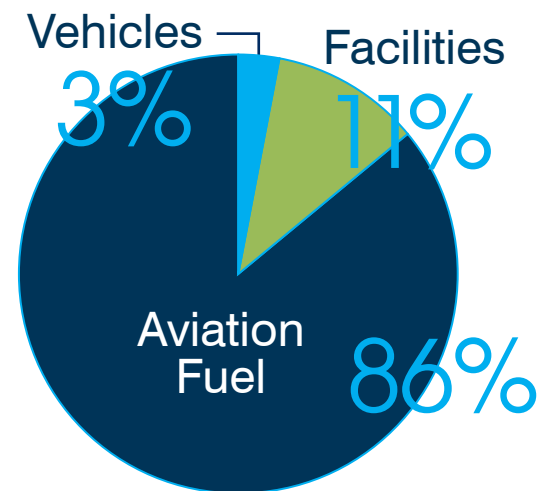


Figure 3: Approximate Air Force Energy Cost Breakdown

To help address its energy vulnerabilities and leverage the cumulative market shares, the Air Force is collaborating with other federal agencies and private industry to identify best practices and implement solutions to improve its energy resiliency. Moving forward, the Air Force will continue to engage in partnerships to help ensure it meets its strategic energy goals and reduces the financial impacts of its energy consumption.



## Risks Associated with Energy

The Air Force relies heavily on specific resources to meet its energy demands. Today, the Air Force's primary source of energy is petroleum-based fuel, which is used for aviation operations, ground vehicles, equipment, and back-up power generation. Aside from its fuel requirement, the Air Force relies heavily on electricity to support its installations, which is mainly generated by public utility companies and obtained through the commercial electric grid. While the electricity is generated using a mix of fuel sources, such as coal, natural gas, nuclear, and renewable energy, the grid distributing the power is aging and vulnerable to both natural disasters and attacks. These vulnerabilities affect all installation-based Air Force missions, including both cyber and space missions, and they present risks to how the Air Force can successfully operate.

### *Mission Risks*

The Air Force is facing a changing threat environment. With installations largely dependent on the national electrical grid, the Air Force needs to be cognizant of and able to respond to the physical threats, cyber threats, and severe weather events that jeopardize grid reliability. Physical attacks, such as theft or deliberate attacks against the infrastructure, and cyber threats to the industrial controls systems can be driven by malicious state and independent actors to damage, disrupt, or direct the operations of energy systems. These emerging and established threats increase the risks of prolonged, widespread disruptions to energy access. Even the shortest disruption can potentially jeopardize critical Air Force missions, particularly space and cyber missions whose energy dependency increases the importance of base energy resilience. This means the Air Force's historic approach to energy resiliency is likely not enough, and we need better analysis of our energy vulnerabilities at all levels: base, mission, campaign, and operations.

## RESILIENCE DEFINITION

The term “**resilience**” means the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from energy disruptions.

– E.O. 13693

Cyber attacks on the energy infrastructure represent a unique and relatively new risk facing energy management, and provide a mechanism to jeopardize a mission. The Air Force, and the energy sector as a whole, is increasingly reliant on information technology and is using that connectivity to pull and transmit data across the entire energy supply chain.

The Air Force also faces challenges in remote expeditionary operations, where the logistics chain for energy and water remains open to disruption and attack. To address these vulnerabilities, the Air Force is pursuing resilient, reliable, and diverse energy supplies and optimizing the energy demand of its weapon systems.



### Financial Risks

Energy is becoming a larger share of the Air Force budget, and it is becoming more difficult for the Air Force to forecast and plan for fluctuations in energy costs. With the austere fiscal environment facing the Air Force and the Nation, energy can pose a financial risk to the Air Force's ability to plan, develop, and acquire the technologies and equipment necessary to sustain air, space, and cyberspace superiority.

### Geopolitical Risks

Although the Air Force's energy needs are currently met, the global demand is increasing and the ability to access energy resources is limited. In addition, even though a large portion of the Nation's energy supplies are produced domestically or in nearby countries, energy exists in a fungible, global market where even small changes in production and disruptions in supplies are felt worldwide. The shrinking gap between global supply and demand is increasing competition for energy resources, which could lead to increased prices, higher potential for conflicts, and the possibility for supply disruptions.

### Environmental Risks

Energy production and consumption carries a long-term environmental risk as well. Most of the negative impacts result from the burning of fossil fuels, which can result in increased air and greenhouse gas pollution and affect the communities where Airmen live and work. Other forms of energy production require large amounts of water, the conversion of farmland to supply the crops necessary for biofuel production, and/or the development of new technologies requiring unique components.

### Future State

For the foreseeable future, the Air Force will continue to consume large quantities of energy to support its mission, and it is essential to have a strong energy posture to ensure energy is available where and when it's needed. Air Force aircraft have long life cycles, and while retrofits can be used to improve performance, the engines will continue to require petroleum-based fuels to operate. The Air Force's strategic energy goals—*Improve Resiliency, Optimize Demand, and Assure Supply*—will help lead the Air Force toward an energy-secure future state where it:



- Identifies and integrates energy efficiency throughout business and planning processes.
- Maintains a robust, resilient, and ready energy posture to ensure the freedom to operate.
- Continues a leadership position where energy, the mission, and Air Force core competencies intersect.
- Promotes integration of new technologies to reduce costs and increase effectiveness, and leverages investments in a constrained resource environment.

To achieve this future state, the Air Force operations community, as the largest energy customer, must be engaged to explore opportunities within their policies, processes, and equipment. Operational decisions play a primary role in determining Air Force energy requirements, and any improvements in optimizing energy use can have a significant impact on enhancing mission assurance through energy assurance. The acquisition and design phase provides the most opportune time for mission owners to engineer a system that makes the optimal use of energy, as opposed to mandating a level of efficiency after the system has already been developed.

## Strategic Trends

The Air Force 30-Year Strategy, *America's Air Force: A Call to the Future*, provides a general path of where the Air Force needs to go to ensure it meets America's needs. It provides an "over the horizon" sight picture and delivers strategic vectors describing how the Air Force needs to look and act as it moves forward. There are four overarching trends and national security challenges that will shape the environment in which the Air Force will operate, and energy is a common characteristic in all four.



### *Rapidly emerging technological breakthroughs*

Advancing technology has a significant impact on the Air Force's use and management of energy, and these advancements can fundamentally change the way it operates. Breakthroughs in the fields of energy production, storage, and efficiency, which could help assure Air Force energy supplies, are emerging at a rapid rate. At the same time, the energy requirements for weapons systems and the supporting infrastructure are changing as new systems are acquired and the reliance on cyber systems grows. It is imperative for the Air Force to maintain an awareness of these advances as well as the positive and negative impacts these advances can bring.

### *Geopolitical Instability*

The availability, or lack thereof, of energy resources has the potential to cause dramatic shifts in a country's or region's stability and economic status. As those shifts occur, the motives and actions of allies and adversaries can shift as well, potentially impacting national security. This interplay between "energy independence" and the geopolitical dynamics among energy-rich nations impacts Air Force operations now and in the future. While the U.S. is becoming increasingly energy independent, our allies are not. Just as the Air Force has led in the development and adoption of aerospace technology, it can also lead in leveraging the operational benefits of resilient energy systems—and in a way that our allies can adopt.

### *Wide range of operating environments*

While recent conflicts have taken place on dry, predominantly land-locked environments with abundant fuel supplies, future conflicts may shift to locations where longer supply chains are required. As the Air Force looks to the future, it must ensure its operational assets and procedures are agile enough to perform at their maximum whether in desert environments, tropical jungles, or over wide swaths of ocean where islands are its bases. From an energy perspective, improving the energy productivity of its weapon systems will increase the capabilities and provide the Air Force with the force it needs.

### *Increasing importance and vulnerability of global commons*

As populations expand and competition for natural resources grows, ensuring the availability of trade lanes and undersea energy stores will become increasingly important. Reliable access to energy stores and the opportunity to transport those resources is necessary. The Air Force, however, is not in a position to solve the issues surrounding the problems of the global commons, which are those areas of the world beyond the control of any one state—sea, space, air, and cyberspace—and that require collective action to solve. The Air Force's ability to operate in air, space, and cyberspace may be impacted as the opportunity to access the global commons constricts.



# A Strategic Approach to Energy in the Air Force

Mission assurance through energy assurance

The Air Force is proud to be a leader in the Nation's ongoing quest to increase the use of clean energy, decrease energy consumption, and reduce the Nation's dependence on energy imports. Optimizing energy use not only saves resources and money, but it is also a force multiplier that allows the Air Force to apply resources and airpower more efficiently and effectively.

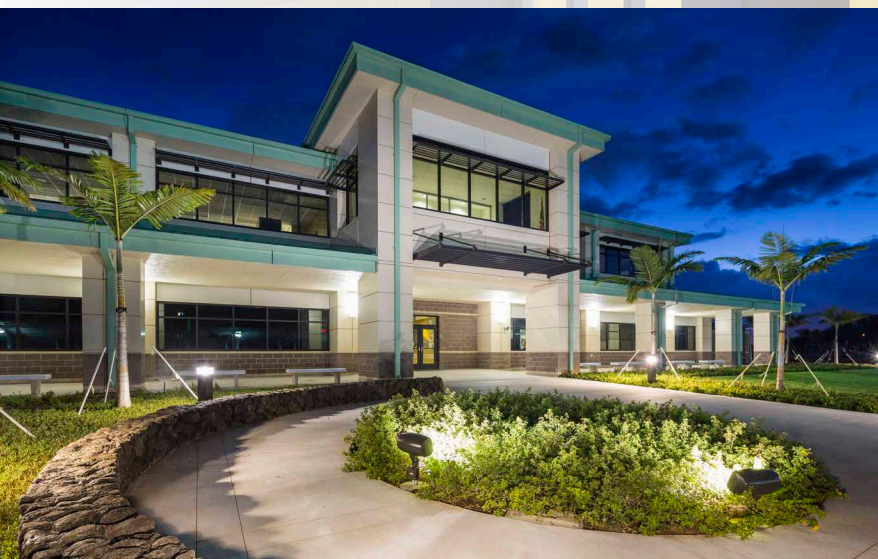
## A Framework for Energy Management

By making the best use of its energy resources, the Air Force achieves an edge toward ensuring operational supremacy and moves towards its strategic vision to enhance mission assurance through energy assurance.

The Air Force Energy Flight Plan provides a management framework to achieve its energy goals—*Improve Resiliency, Optimize Demand, and Assure Supply*—and continually improve energy utilization to maximize productivity and promote energy resiliency. This framework defines and further develops each goal to include measurable strategic

objectives essential to helping achieve the energy vision, sustain readiness, and support the mission. Each objective is linked to the Air Force's Strategic Master Plan.

Accomplishing these goals and objectives requires a convergence of conditions: appropriate investments to make the Air Force's energy vision a reality; personnel to execute energy-related endeavors; and an evolving knowledge of existing and emerging energy issues affecting the Air Force. Given the critical role of energy in Air Force operations, the benefits of energy investments should be weighed carefully against all initial and recurring costs. Doing so will allow energy initiatives to be evaluated and appropriately funded along with other Air Force goals in order to maximize the use of Air Force resources. Table 1 provides a synopsis of the intent and expected outcome of each strategic goal.



## Air Force Energy Strategic Goals

Goal	Intent	Expected Outcome
1. Improve Resiliency	<ul style="list-style-type: none"> <li>- Identify vulnerabilities to energy supplies, such as physical and cyber attacks or natural disasters</li> <li>- Mitigate impacts from disruptions in energy supplies to critical assets, installations, and priority missions</li> <li>- Develop ability to prioritize resources against risks to the mission</li> <li>- Advance physical and cyber security solutions to protect critical energy assets and secure industrial controls systems</li> </ul>	<ul style="list-style-type: none"> <li>- Improved responsiveness to disruptions to energy supplies</li> <li>- Increased ability to quickly resume normal operations and mitigate impact to the mission</li> <li>- Prioritized response plans and solutions to mitigate risks from the tail (logistics supply chain) and the tooth (energy demand in operations)</li> <li>- Assured ability to provide energy for mission-critical function</li> </ul>
2. Optimize Demand	<ul style="list-style-type: none"> <li>- Increase energy efficiency and operational efficiency for Air Force systems</li> <li>- Enhance capabilities by focusing on the energy required to achieve the Air Force mission</li> <li>- Build energy considerations into Air Force research, development, test and evaluation (RDT&amp;E) efforts</li> </ul>	<ul style="list-style-type: none"> <li>- Decreased amount of energy required by Air Force systems and operations without negative mission impacts</li> <li>- Increased flexibility, range, and endurance in all operations</li> <li>- Matured long-term, focused solutions to Air Force energy challenges</li> </ul>
3. Assure Supply	<ul style="list-style-type: none"> <li>- Integrate alternative sources of energy compatible with mission requirements</li> <li>- Diversify drop-in sources of energy</li> <li>- Increase access to reliable and uninterrupted energy supplies</li> </ul>	<ul style="list-style-type: none"> <li>- Access to clean energy resources and supply chains based on asset and mission priorities</li> <li>- Increased flexibility in all operations</li> <li>- Increased ability to sustain mission</li> </ul>



## Goal 1 – Improve Resiliency

Energy supplies are susceptible to shortages and price volatility due to existing and increasing global competition, as well as to disruptions resulting from natural disasters, physical attacks, and cyber attacks. To maintain freedom of operations, the Air Force will continue to *Improve Resiliency*, ensuring it has the ability to continue operations, recover from energy interruptions, and sustain the mission. It is essential for the Air Force to have the programs and tools in place to both systematically consider these risks and address potential short- and long-term disruptions of energy supplies. An inherent part of resiliency is the reliability of installation energy distribution systems. The reliable operation of an energy system focuses on continued operation of the system in the event of a disturbance, such as a cyber attack, while resiliency focuses on the recovery following such an event.

Identifying and planning for potential threats to energy supplies serves as the foundation for energy security at Air Force installations. This goal and its associated objectives support those planning activities and help ensure the Air Force has the capabilities needed to:

- Evaluate and prioritize risks to energy supplies efficiently, consistently, and with minimal burden.
- Mitigate impacts from disruptions in energy supplies.
- Assure continuity in operations when energy supplies are interrupted.
- Accommodate highly uncertain fluctuations in energy availability and cost.

This goal will also help the Air Force identify the resources (e.g., trained Airmen, planners, architects, engineers) and processes (e.g., planning, programming, budgeting, research, and design) needed to develop and sustain capabilities required to ensure a resilient energy supply. The Air Force’s approach to *Improve Resiliency* involves the exploration of different mechanisms, including:

- Alternative paths to sustain existing operations.
- Diversification throughout the existing energy supply chain, with a focus on domestically-derived supplies where appropriate.
- Improvement of operational efficiency and energy efficiency for existing systems.
- Inclusion of energy considerations in future systems and upgrading of current systems.

- Implementation of planning and analysis tools, such as wargaming, to prepare for disruption in energy supplies; and
- Utilization of advanced smart meters and microgrids to improve energy management, flexibility, security, and reliability.

GOAL 1: Improve Resiliency	
Strategic Objectives	SMP Alignment <sup>1</sup>
1.1. Eliminate 20% of the single point(s) of failure for facility energy associated with Air Force owned and operated critical infrastructure by FY25	FH2.7
1.2. By FY20, increase the use of energy resiliency technologies and partnerships for critical infrastructure to improve energy security. Incorporate energy resiliency considerations, such as cybersecure microgrids, for critical infrastructure by FY20	FH1.3
1.3. By FY19, finalize energy plans for installations that together compose 75 percent of the Air Force’s installation energy consumption and include requirements to enhancing energy resilience	FH2.7
1.4. Incorporate energy awareness into training by FY18 to enable Airmen to recognize the impact of energy on critical operations	AG3.3
1.5. Develop an approach by FY18 to partner with joint, international, federal, state, local, and private partners to improve energy security	IN3.3
1.6. By FY36, all mission-critical functions will have assured access to a reliable supply to energy at all times	FH2.7

<sup>1</sup> Nomenclature aligned to Air Force Strategic Master Plan Vectors (SMP): AG=Agile; FH=Full-Spectrum-Capable, High-End-Focused; IN=Inclusiveness; MDA=Multi-Domain Approach to the Air Force’s five core missions.



## Focus on Resilient Energy Systems for Mission Assurance

The Air Force's ability to accomplish its mission—whether executing today's fight or training for future fights—is dependent on electric and other critical utilities providing installations the power, heat, and water they need to operate. As the Air Force has developed new technologies and capabilities, it has increased its reliance on the aging and outdated U.S. electric grid. The Air Force is focused on procuring reliable, resilient, cost-effective power to ensure our Airmen's ability to win the fight, balancing readiness and modernization of Air Force installation energy infrastructure. There are three lines of effort that categorize Air Force efforts to enhance installation energy assurance: assess vulnerabilities; scale resilience and protect & defend; and rapidly deploy game changing technologies.

### *Assess Vulnerabilities*

Air Force missions transcend geographic boundaries, with a networked total force operating around the globe. Understanding how these missions are linked together and identifying critical nodes reliant on uninterrupted access to electricity is essential to optimizing and prioritizing resources. The Air Force will identify and analyze end-to-end operational mission threads, and then incorporate those analyses into wargames and exercises to inform mission planning, investment choices, and resource allocations.

### *Scale Resilience and Protect & Defend*

The Air Force is aggressively pursuing renewable and alternative energy projects, which can serve as critical investment building blocks to resilient energy systems. To enhance these efforts, the Air Force stood up its Office of Energy Assurance (OEA), which serves as a centralized program office dedicated to establishing an Air Force-wide storefront for facility energy projects, with a focus on large-scale resiliency projects. The OEA will leverage partnerships within DoD and will contribute to the Air Force's strategic energy agility and resiliency. OEA will address energy resilience issues from an enterprise level, develop comprehensive energy assurance plans, and provide dedicated project management and facilitation support to installations. Part of scaling energy resilience is ensuring the Air Force has the cybersecurity systems and teams in place to protect and defend its internal control systems. Without those protections in place, efforts to scale resilience are negatively impacted.

### *Rapidly Deploy Game Changing Technologies*

The Air Force must take a holistic, enterprise-wide approach to ensuring critical missions and capabilities remain functional during long-term or widespread energy disruptions. The Air Force will leverage existing tools and authorities to develop resilient energy demonstration projects, with a sustained focus on missions and installations. These projects will integrate cutting-edge energy efficiency, security and controls systems technologies, and innovative business models. The Air Force will ensure investments in demonstration projects are targeted to support comprehensive framework development for energy assurance projects that can be replicated across the enterprise.



## Goal 2 – Optimize Demand

The Air Force is engaged in global operations every day, from overseas contingency operations and humanitarian and disaster relief operations to defending the homeland and providing strategic deterrence. With energy costs continuing to increase and budgets becoming more fiscally constrained, the Air Force is looking to *Optimize Demand* through operational and logistical efficiencies and new technologies as a way to improve its energy resiliency and enhance its mission effectiveness. By integrating energy efficient technologies and fuel optimization measures, the Air Force can stabilize and reduce operational and infrastructure energy demand while enhancing its mission and range. The intent of this goal is to ensure the Air Force is productively and efficiently using energy, while capitalizing on technological and procedural best practices.

Reducing the Air Force's need for energy is the single best action it can take to improve its energy resiliency. It decreases reliance on foreign energy sources and an aging commercial infrastructure, reduces the financial resources the Air Force needs to commit to energy, and increases the impact on-base clean energy sources can have. The Air Force will consider any project that enables it to make better use of the resources it uses, including those projects that would reduce overall energy consumption but could negatively impact its energy efficiency goals.

The *Optimize Demand* goal and objectives address demand-side energy management issues and supports various activities to build and sustain the capabilities needed to decrease the amount of energy required to operate Air Force systems and conduct operations. Part of this is ensuring that the Air Force has the ability to collect and analyze energy data to manage consumption effectively by using advanced tools and management systems, such as smart meters. This goal and subsequent objectives target aviation fuel, expeditionary fuel, tactical and non-tactical ground fuels, and installation energy, without compromising safety or mission capabilities to help the Air Force:

- Improve aviation energy productivity across all aircraft types by focusing on training and operational effectiveness through innovation and cost-effective investments.
- Reduce ground vehicle fuel and facility energy requirements, which will help reduce dependence on commercial supply and delivery systems.

- Implement requirements for improved energy productivity (where practicable and feasible) in specifications for design, production, and operation activities across every Air Force domain.
- Promote RDT&E initiatives to develop more energy efficient advanced propulsion and aircraft aerodynamic technologies to enhance operational capability.



- Implement planning activities to identify, evaluate, and/or prioritize opportunities to optimize energy demand, including changes in existing operations.
- Employ best management practices for energy-efficient management of servers and data centers.

In order to *Optimize Demand*, the Air Force must improve energy performance of operational platforms and enhance the energy efficiency of fixed infrastructure. By building more efficient platforms and more effectively utilizing resources, the Air Force can improve the range and endurance of its weapon systems and increase its combat capabilities. The Air Force has a rich history of capitalizing on new technologies for new capabilities, and energy considerations must be included in those activities.

## GOAL 2: Optimize Demand

Strategic Objectives	SMP Alignment
2.1. Improve overall Air Force aviation energy efficiency by 10% by FY20 (2011 baseline)	FH1.1 FH2.2
2.2. Reduce energy intensity (energy consumed per gross square foot) by 25% by FY25, compared to FY15	AG2.1 AG2.6
2.3. Reduce reliance on and consumption of petroleum fuels for ground-based vehicles to achieve a 30% reduction in fleetwide per mile greenhouse gas emissions by FY25, based on an FY14 baseline	AG2.1 AG2.6
2.4. Ensure energy key performance parameters (eKPP) and energy supportability analyses (ESA) for 100% of future acquisition programs with operational energy requirements are addressed by FY18	AG2.1 AG2.3 AG2.5

### Focus on Performance Contracting

Third-party performance contracts, such as Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs), provide the Federal Government with a partnership opportunity to procure energy savings and facility improvements with no up-front capital costs. The Air Force is pursuing ESPCs across its facilities, targeting depots and data centers, and exploring new ways of bundling ESPCs to take advantage of economies of scale. These projects not only provide an avenue for the Air Force to optimize its energy demand, but also help modernize aging Air Force infrastructure. By partnering with other Services, the Air Force is also leveraging other contract mechanisms, such as the U.S. Army Corps of Engineers and the Defense Logistics Agency (DLA), to increase its program output.

To fully maximize the use of third-party performance contracts, the Air Force will continue its focus on increasing the use of third-party financing tools to develop potential energy security projects and increase its investment in new capital equipment and energy efficiency. Part of this includes identifying and maintaining a robust pipeline of potential energy saving projects to take advantage of funding opportunities as they arise. Successful projects are those that are technically sound and offer a positive business case for the Air Force.

#### *Third Party Performance Contract for Mobile Assets*

While ESPCs are currently only available for facility improvement projects, the Air Force is exploring the potential for similar contracts for its aircraft and ground vehicle fleets. While this effort is still in its infancy and will have to overcome significant challenges, it is innovative ideas like this that will help the Air Force maintain its ability to adapt and respond faster to the changing environment.



## Goal 3 – Assure Supply

The Air Force is committed to diversifying the types of energy and securing the quantities necessary to perform its missions as a way to *Assure Supply*, both for near-term benefits and long-term energy security. Air Force operations are heavily dependent upon petroleum and petroleum-derived fuels, and this dependency poses significant strategic and security vulnerabilities where long-term disruptions would put pressure on energy supplies for the U.S. and its allies. The ability of the Air Force to ensure continuity of operations is dependent upon not only the delivery of reliable and uninterrupted energy supplies in the necessary quantities, but also on the adaptability of mission platforms to operate on diverse energy sources, such as alternative fuels.

Assurance of the Air Force’s energy supply is not limited to its aviation operations—it also includes its facilities, ground vehicles, equipment, cyber systems, and space assets. The Air Force is focused on developing on-site sources of clean energy, particularly those sources that can protect the Air Force from grid failure or other supply disruptions. Increased use of on-site clean energy can provide the Air Force with consistency in energy pricing, as well as promote positive environmental benefits by avoiding greenhouse gas emissions.

The Air Force is expanding its use of alternative fuel and plug-in electric vehicles. The use of such vehicles could help insulate the Air Force against fuel price volatility, improve energy security by decreasing dependence on foreign oil, and address environmental concerns, such as air quality. *Assure Supply* addresses supply-side issues and is critical to sustaining an energy advantage. These goals and objectives support various planning, programming, investment, and research activities to build and sustain the capabilities needed to assure energy supplies. The Air Force applies these different types of activities, in various forms, among different groups of energy consumers. The different applications of these shared activities help the Air Force:

- Identify and implement requirements for clean energy (where practicable and feasible) in specifications for design, production, and operations, as well as specifications for products and equipment.

- Promote research, development, test and evaluation initiatives to advance new technologies and evaluate new sources of energy that increase the Air Force’s ability to incorporate clean energy throughout the portfolio of energy-consuming platforms.
- Utilize third-party investment mechanisms for utility-scale projects that increase the capacity to produce clean energy and the capabilities to better distribute and utilize these supplies.
- Identify and implement infrastructure that supports the use of clean energy supplies.
- Implement technologies that create capabilities to consume clean energy throughout the portfolio of energy consumers.

### GOAL 3: Assure Supply

Strategic Objectives	SMP Alignment
<b>3.1.</b> Increase use of cost-competitive drop-in alternative aviation fuel blends for non-contingency operations by FY25	<b>AG2.4</b>
<b>3.2.</b> Increase facility use of clean energy by 25% by FY25	<b>FH2.7</b>
<b>3.3.</b> Increase use of alternative fuels in ground vehicles and equipment by FY20	<b>FH2.7</b>
<b>3.4.</b> Eliminate 100% of energy shortfalls to improve contingency operations by FY35	<b>FH2.7</b>



## Focus on Maintaining the Air Force's Supply of Aviation Fuels

Aviation fuel consumes approximately 86 percent of the Air Force's energy budget and represents a critical requirement for the Air Force to achieve its mission. With that requirement in mind, the Air Force is working with DLA to ensure the Air Force has: 1) the robust fuel storage and agile infrastructure capabilities to maintain the supplies necessary for critical operations, and 2) the ability to access both traditional and alternative aviation fuels.

### *Fuel Basing Strategy*

The Air Force needs to ensure it does not accept unnecessary risks concerning the transmission, storage, and distribution (TS&D) and shared infrastructures for its liquid fuels, particularly when planning for future conflicts. Within the U.S., while fuel infrastructure is at a much lower risk compared to the electric grid, it can be negatively impacted by natural events that can cause significant reductions in refining capacity. For example, Hurricanes Katrina and Rita in 2005 caused refinery outages of more than 4.5 million barrels per day, and more than 20 refineries were shut down on the worst day, representing a loss of 67 percent of the Gulf's capacity and 28 percent of national refinery capacity.

Outside the continental U.S., the greater risk for the Air Force is the pre-positioning of its starter stocks and then the continued delivery to meet the demand of geographically diverse locations. The Air Force must continue to collaborate with the Combatant Commands and DLA to ensure it is strategically postured to quickly react to emerging threats. Part of this includes hardening the TS&D infrastructure wherever practical to enhance resilience and reliability, as well as examining how the availability of fuel impacts the initial stages of the campaign.

### *Alternative Aviation Fuels*

To expand the fuel options available to its fleet, the Air Force has certified its entire fleet to fly on two alternative aviation fuel blends. It focused on two processes to develop alternative fuels – a synthetic fuel produced using the Fischer-Tropsch process and a biofuel produced by hydroprocessing esters and fatty acids. These alternative fuels are then blended with traditional JP-8 or Jet A at a ratio of up to 50/50 to create the alternative fuel blends. The Air Force is not and will not be a producer of aviation fuels, and it will continue to rely on private industry to produce the fuels it needs.

The Air Force is fully prepared to purchase and consume alternative aviation fuels, provided those fuels are drop-in replacements and cost competitive with traditional petroleum-based jet fuels. Both fuel blends are included in the military and commercial specifications, indicating the Air Force is ready, willing, and able to use those blends. DLA has actively solicited for alternative aviation fuel blends in previous solicitations and is monitoring the market to help the Air Force prepare for future alternatives. The Air Force is feedstock agnostic and is looking for those fuels that meet its cost, environmental, and technical specifications. By preparing for a variety of alternatives, the Air Force is ensuring it will be ready for whatever



private industry is able to bring to market in order to improve its energy security.

# Ways to Achieve Energy Goals

21st Century approaches are needed to address energy challenges, not 20th Century tools

The Air Force maintains a variety of policy processes and legal tools to assist with developing energy projects, as well as ensuring the program is moving effectively and efficiently. Benefits of using these tools include reducing operating and service costs and risks and achieving economic goals and interests.

## Ensuring an Energy-Aware Culture

The Air Force must develop and sustain capabilities to improve its energy security, a process that begins with Airmen. This requires the Air Force to continue focusing on how it approaches energy by increasing energy awareness and understanding. By fostering an energy aware culture, the Air Force will ensure that Airmen will make energy a consideration in all they do and, in turn, maximize the potential of their weapons systems.

To ensure success, the Air Force also needs cooperation at every level, coupled with an understanding of how energy usage impacts each mission. Culture change is not easy; however, such a change does not face the same funding challenges as capital improvements. By employing outreach and education campaigns, as well as assessments of Air Force energy requirements, the Air Force will work to build an energy-aware culture.

## Identifying Innovative Approaches

To meet the energy challenges of today and the future, the Air Force will continue to rely on its Airmen. The Air Force culture of innovation exists in the Airmen who integrate new inventions, utilize their own ingenuity, and leverage their mission experience to develop and deploy game-changing solutions.



## Governance and Oversight

To provide leadership and ensure energy is a consideration in everything the Air Force does, the Air Force maintains governance bodies across the Service—at Headquarters Air Force (HAF), at the major commands (MAJCOM), and at installations. Generally, the role of these cross-functional bodies is to provide guidance and oversight, as well as evaluate the policies, programs, and resources needed to meet the Air Force energy goals and objectives. By integrating energy management across mission areas and implementing cross-functional strategies and policies, the Air Force is able to improve its operational capabilities and maximize fiscal resources. Given developments in technology, shifts in resource availability, and changes in operational requirements, the Air Force approach to energy management must continue to evolve.

## Partnerships

Active interaction from within and outside the government will help expand the possibilities in addressing energy solutions based on the work of others. Air Force community partnership initiatives, both public-public and public-private, offer opportunities to leverage resources and capabilities of installations, state and local communities, and commercial entities to achieve mutual value and benefit. These partnerships can take the form of shared resources, thus potentially reducing the energy footprint of an installation; joint research projects; or collaborative projects to reduce energy demand or increase the available supply. Similarly, private industry and partner nations can be enlisted to team with Air Force personnel to share examples of best practices and other initiatives that could benefit the Air Force mission.

## Financing

Similar to partnerships, the Air Force needs to look inside and outside the Air Force to advocate for energy improvement. To accomplish many of its energy goals, the Air Force is looking toward industry partnerships to provide both third-party capital and innovative ideas that can help the Air Force meet its goals. Optimizing these tools makes it possible to do more projects—maximizing the energy benefits of each while minimizing the costs. The use of third-party financing and privatization represents the Air Force's primary approach to achieving its installation energy goals.

### *Performance Contracting Tools*

Performance contracts allow the Air Force to partner with private energy service companies and utilities to implement energy efficiency improvements at federal facilities by paying for the investment over time from guaranteed savings. Under ESPCs and UESCs, utilities or energy service companies identify energy saving improvements, design a cost-effective project to meet

agency needs, arrange for financing, and ensure that sufficient energy and energy-related cost savings are available to pay for the project costs up to a 25-year term, after which all cost savings accrue to the Air Force. Projects may include lighting and HVAC upgrades, energy management infrastructure, water conservation improvements, and construction of clean power generation, such as solar photovoltaics and combined heat and power.

### *Enhanced Use Leases and Power Purchase Agreements*

The Air Force is also looking at the full spectrum of clean energy project types as a way to improve its energy security posture and to monetize non-excess assets, such as land which is not, for the time involved, needed for a public purpose. An Enhanced Use Lease (EUL) is a cooperative arrangement between the Air Force and a private developer where the Air Force provides a long-term lease of an underutilized property to the developer for its use. In return, the Air Force receives a financial benefit, such as reduced energy rates or an in-kind consideration of a value not less than the Fair Market Value of the property. The latter might include construction of resilient utility systems, energy conservation or demand reduction features in facilities, or first right to the electricity in the event of a grid disruption.





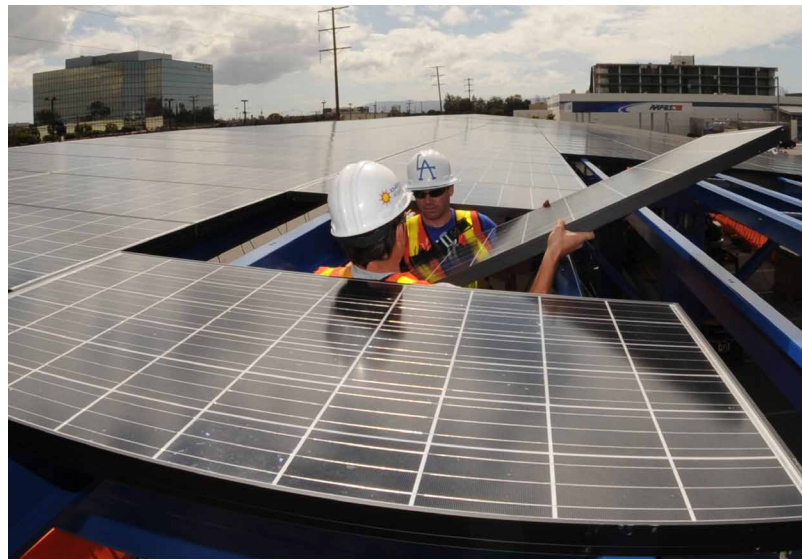
Under a power purchase agreement (PPA), a developer installs a clean energy system on Air Force property under an agreement where the Air Force will purchase the power generated by the system. The Air Force pays for the system through these power payments over the life of the contract. After installation, the developer owns, operates, and maintains the system for the life of the contract. PPAs allow the Air Force to implement on-site clean energy projects with no upfront capital costs.

### Utilities Privatization

Utilities privatization (UP) establishes a fiscal and operational partnership and direct investment for both the Air Force and utility system providers. Privatization of utility systems involves a “bill of sale” conveyance of the real property to a third party, such as a municipal, private, regional, district, or cooperative utility company. Under this approach, the Air Force conveys the entire system and no longer owns, operates, maintains, or repairs these systems. The agreement also includes a utility service contract for operations, maintenance, and recapitalization for a specified period of time, not to exceed 50 years. UP provides a benefit to the Air Force since a system at industry standard improves reliability, reduces commodity consumption, and lowers the cost of system operation, maintenance, repair and recapitalization over the long term. Paradoxically, the most significant benefit is also the biggest challenge: maximizing reliability and resiliency requires significant near-term investment to eliminate system deficiencies. By divesting the Air Force of these utilities, Active, Guard, and Reserve installation commanders can focus on operations and core defense missions and functions, rather than repairs and upgrades to utility systems.

### Installation Energy Plans

An installation energy plan (IEP) represents the integration of strategic guidance, plans, and policies into a holistic roadmap that enables the installation to work constructively towards enhancing mission assurance through energy assurance. Installation commanders should work collaboratively with all tenant organizations and mission owners to develop an IEP that considers the mission, future plans, and critical requirements. These plans should represent a data-driven approach that incorporates opportunities and constraints to mitigate energy risks and vulnerabilities. In the end, Air Force installations will have a living document in place that prioritizes known projects and programs, but also offers the



agility necessary to respond to unforeseen changes in mission, requirements, or supplies.

### Technological Improvements: Lead, Watch, and Follow

Energy technologies are advancing rapidly—advanced batteries are able to store more energy and solar cells have almost doubled their efficiency in the last few years—and new inventions along with innovative applications of existing technologies are constantly becoming available. The Air Force needs to continue to push the envelope in using the technologies and tools it has at its disposal.

The Air Force must continue to identify near-, mid-, and long-term solutions to improve its energy security, from new technologies to improved policies. This does not require the Air Force to lead in every area, but rather take advantage of its core competencies and strengths. The Air Force will continue to develop new technologies through research, development, and demonstration in areas that are critical enablers of core missions and associated platforms. In other areas, the Air Force should follow or watch technologies originating from external organizations to advance operational robustness, resiliency, and readiness.

The U.S. Department of Energy, private industry, and America’s universities and colleges are doing great work on developing new sources of energy, improving energy storage systems, and increasing energy productivity. The Air Force sees wisdom in continuing to partner with those acknowledged experts, which enables the Air Force to focus on providing airpower options to the Nation.

# Moving Forward with an Integrated Approach to Energy

Effective and efficient energy management is a dynamic process

From aviation operations to installation infrastructure within the homeland and abroad, energy enables the dynamic and unique defense capabilities that allow the Air Force to fly, fight and win in air, space and cyberspace. Effective and efficient energy management is necessary and critical for assuring energy availability today and energy sustainability into the future. The Air Force is taking a coordinated, proactive, and comprehensive stance toward energy management through the integration of all three of its strategic energy goals. This approach will lead to increased energy security and reduced energy costs, and it will prevent potentially conflicting and expensive activities.

## Cleaner, Cost Competitive, and Resilient

As it moves to enhance mission assurance through energy assurance on its installations, the Air Force must combine existing, proven technologies and practices with new and emerging technologies. While renewable energy development is good for national energy security as new sources can increase grid diversity, without a direct feed to an Air Force installation, those projects do not dramatically improve Air Force resiliency. As the Air Force evaluates new energy sources or technologies, it is important to consider three characteristics: reliable/resilient, cost-competitive, and clean (Figure 4).

This comprehensive approach to installation energy challenges will holistically optimize cost and provide resilient, cleaner sources of energy by balancing the objectives of Air Force energy projects, including energy efficiency, renewable energy, energy resiliency, and other energy projects. The core principles below will continue to characterize Air Force installation energy projects, but with an increased focus on meeting multiple objectives within single projects.



Figure 4: Three Characteristics of Future Energy Projects

Resilient and reliable are the most important of the three characteristics. The Air Force needs energy to ensure it can complete the mission, and every Air Force energy project should be designed through the lens of enhancing energy resiliency with the strategic energy agility to maintain critical mission functions even during unexpected disruptions. And this applies to both energy and the technologies we use. Even with the world's cheapest energy or the most efficient aircraft, if the energy or aircraft is inconsistent or unreliable, it is useless.

Cleaner is the next characteristic. As stated in the President's National Security Strategy, climate change is an urgent and growing threat to the national security, and the Air Force is moving to cleaner sources of energy to reduce its impact. Renewable and other distributed energy technologies are key components of energy agility and assurance, especially when projects are on site and capable of delivering continuous energy when the grid is disrupted.

Cost-competitive is the final characteristic. In the current fiscal environment, the Air Force does not have the ability to pay for niche energy sources, and it will purchase the most economical sources of energy and technologies that meet the requirements. While the Air Force will pursue projects that save money and leverage third-party investment, the focus will be to prioritize resources to projects that enhance energy resilience and reliability.

The Air Force recognizes while these three characteristics are not applicable in every situation, each characteristic is a spectrum and not “either-or” choices. Additionally, the Air Force also takes a broader perspective than just the initial costs. With weapons systems and installations being in service for decades, the Air Force needs to consider the full lifecycle of its purchases and how energy is addressed. Energy sources and technologies that hit the “sweet spot” and are more resilient, cheaper, and cleaner than what is currently in use will receive significant consideration, now and in the future. While every project will not be able to clearly demonstrate every characteristic, the Air Force will expect each project to demonstrate a clear connection to at least two principles or have a strong mission justification.

## Enhancing Air Force Combat Capabilities

Similar to the installation energy program, mission assurance is the basis for the Air Force’s operational energy program. By anchoring our approach on our core competencies and focusing on policies, processes, people, and platforms (Figure 5), the Air Force can enhance its combat capabilities. By understanding the impacts of changes made across those four focus areas, we can optimize our combat capabilities and maximize our combat readiness while reducing mission risks posed by potential fuel supply challenges. With more than 5,000 aircraft in the Air Force fleet and an annual demand for over two billion gallons of jet fuel to support operations and training, optimizing how the aircraft and crews use fuel can generate significant increases in capabilities.

By adjusting the policies governing areas as diverse as aircrew to aircraft ratios, en route and landing fuel requirements, aircraft basing and airspace location, and aircrew training requirements, the Air Force has already seen a direct and measurable impact on the amount of fuel required to organize, train, and equip aircrews to deliver combat capabilities.

As we continuously review and update Air Force policies to ensure we operate at the highest level possible, it is imperative the Air Force understand the mission impacts resulting from energy requirements and work towards mitigating those impacts.

Similarly, changes in the processes we employ in the training of our Airmen and the execution of our missions can have measurable operational energy implications and carry corresponding impacts to combat capability. Whether it is command and control, aircraft and mission scheduling, or aircraft loading, seeking optimization opportunities and establishing efficient standards will have a positive impact on our overall combat capability.

Influencing the behavior of the people carrying out and supporting the mission to optimize our fuel consumption is vitally important. Through the identification and sharing of enterprise wide best practices, and exposing people to operational energy optimization techniques in education and training venues, the Air Force will enable our people to maximize mission effectiveness.

Although the Air Force faces financial challenges in developing and fielding technological improvements, investments in the energy efficiency of our aircraft platforms often provides significant opportunities for fuel savings, reduced maintenance requirements, and increased mission capabilities.

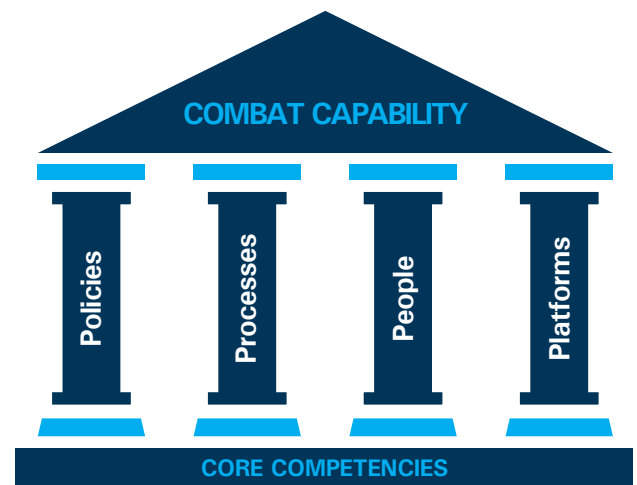


Figure 5: Operational Energy Pillars



The Air Force, through the HAF, Major Commands and Core Function Leads, needs to look beyond traditional approaches, evaluate the way the Air Force trains and operates, and promote opportunities to refine the processes and policies to enhance its combat capabilities to respond to a wide range of potential challenges and global operational environments.

## Energy and the Air Force of 2036

The culmination of any Air Force effort in a crosscutting area—from readiness to safety to energy—is to ensure that the Service is positioned for the future. Part of this includes guiding changes and investments to weapon systems and current installations, but it also includes informing designs for those assets that may be built in the future in deployed and permanent environments. The Air Force of the future would rely on an agile force, efficient aircraft, and secure systems, all with increased capabilities compared to today's systems. These efficiencies and increased capabilities will result in steady-state savings. Missions would be launched from installations powered by clean energy sources connected to both a centralized storage facility and directly to facilities. Excess power generated during the day or night from clean sources would be stored and used during high demand periods, and the installation would rely on distributed sources of energy to reduce single point vulnerabilities and rely on energy from the main grid as backup—not the other way around.

## The Air Force's Innovative Spirit

The Air Force's strategic approach to energy management outlined in this plan is an evolving framework designed to be a reference point for all Air Force personnel. Energy management is a dynamic process that will necessitate the continuous incorporation of new information and developments on the energy front, and thus the Air Force views this plan as an adaptive framework for accomplishing

Air Force energy goals and improving its energy security.

To be successful and achieve its energy vision, the Air Force needs the innovative spirit of its Airmen to identify ways to optimize energy usage throughout the Air Force. That approach has long been a part of the Air Force spirit. Even as far back as the Tokyo Raid on 18 April 1942, Airmen have had to consider the impacts of the availability of energy, and they have been implementing bold, novel solutions to provide an energy advantage over their adversaries. Through a strong commitment to provide mission assurance through energy assurance, the Air Force will continue to remain unsurpassed in its ability to fly, fight and win in air, space and cyberspace.

### A VISION OF THE FUTURE

The AF Future Operating Concept envisions a future in which information technologies permeate almost every object. Cyberspace will no longer be clearly separable from the physical domains, as actions in cyberspace will create effects in all other domains. The amount of human knowledge will have potentially increased by orders of magnitude, and technological advancement will empower individuals, groups and non-state actors to develop and employ capabilities previously reserved to nation-states. It will be impossible to achieve and maintain complete, permanent technological or informational advantages. Instead, advantages will be transient and belong to persons and organizations that display bold, adaptive, and innovative behaviors.

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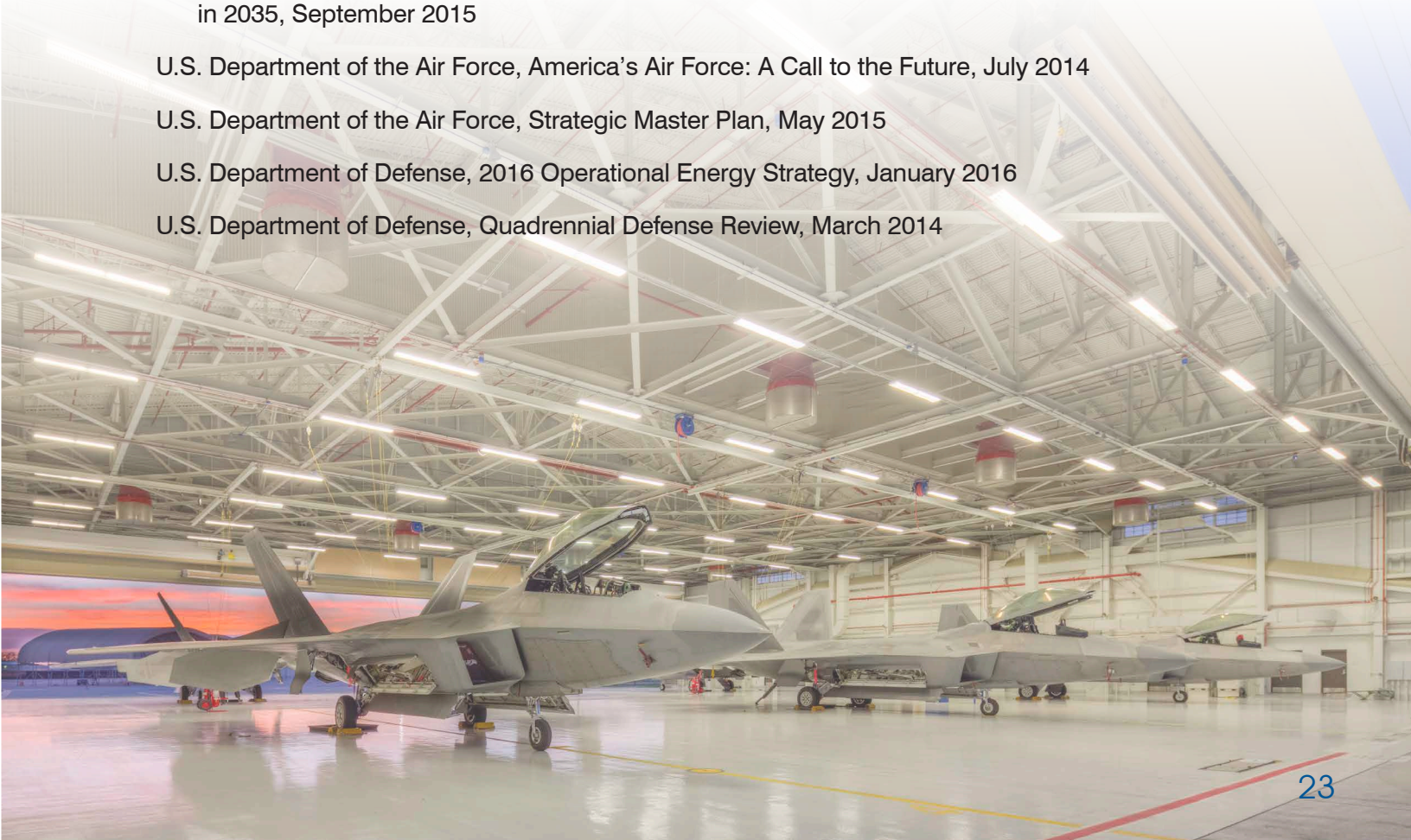
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## Appendix 2: Definitions

**Alternative Energy** – Energy generated from technologies and approaches that advance renewable heat sources, including biomass, solar thermal, geothermal, waste heat, and renewable combined heat and power processes; combined heat and power; small modular nuclear reactor technologies; fuel cell energy systems; and energy generation, where active capture and storage of carbon dioxide emissions associated with that energy generation is verified.

**Alternative Fuel** – Means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary of Energy, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas, including liquid fuels domestically produced from natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits. *This definition does not apply to alternative aviation fuels.*

**Alternative Jet Fuel** – Hydrocarbon-based, drop-in fuels that are derived from non-petroleum sources.

**Clean Energy** – Renewable electric energy and alternative energy.

**Critical Infrastructure** – Cyber and physical systems and assets so vital to the Air Force that the incapacity or destruction of such systems and assets would have a debilitating impact on the Air Force's ability to execute its missions.

**Energy** – Any usable power, including, but not limited to, electricity and power produced from coal, petroleum products, steam, natural gas, propane, military operational fuels and propellants, alternative fuels, and alternative and renewable energy sources, such as solar, wind, geothermal, and nuclear.

**Energy Assurance** – Activities across three main categories—preparation and planning, mitigation and response, and education and outreach—focused on the goal of energy resiliency.

**Energy Management** – The process of developing, executing, and overseeing plans, programs, and initiatives to achieve energy goals and objectives across all functional areas.

**Energy Resilience** – The ability to prepare for and recover from energy disruptions that impact mission assurance on military installations.

**Energy Security** – The state of having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet mission essential requirements.

**Facility** – A building, structure, or other improvement to real property.



**Installation Energy** – The energy used to power all facilities located on military installations and enduring locations, as well as fuel for the non-tactical fleet vehicles used at those locations and the energy consumed in manufacturing, maintenance, and other processes.

**Military Installation** – A base, camp, post, station, yard, center, or other activity under the jurisdiction of the Secretary of a military department or, in the case of an activity in a foreign country, under the operational control of the Secretary of a military department or the Secretary of Defense, without regard to the duration of operational control.

**Mission Assurance** – A process to protect or ensure the continued function and resilience of capabilities and assets – including personnel, equipment, facilities, networks, information and information systems, infrastructure, and supply chains – critical to the performance of DoD Mission Essential Functions (MEF) in any operating environment or condition.

**Operational Energy** – Energy required for training, moving, and sustaining military forces and weapons platforms for military operations. The term includes energy used by tactical power systems, generators, and weapons platforms.

**Process Energy** – Energy consumed in support of a manufacturing, industrial, or commercial process other than conditioning spaces and maintaining comfort and amenities for the occupants of a building. This includes, but is not limited to, energy consumed by industrial facilities (such as maintenance depots), data centers, simulators, and laboratory equipment.

**Project** – A planned undertaking having a finite beginning and ending, generally involving definition, development, and production, to create, improve, or refurbish a facility, weapon platform, or other combat support tools or systems. A project may be the whole or a part of a program.

**Reliable Operation** – Operating the elements of the bulk-power system within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements.

**Renewable Energy** – Energy produced by solar, wind, biomass, landfill gas, ocean (including tidal, wave, current, and thermal), geothermal, municipal solid waste, or new hydroelectric generation capacity achieved from increased efficiency or additions of new capacity at an existing hydroelectric project.

**Resilience** – The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from energy disruptions.

