2022 ANNUAL REPORT

AIR FORCE OPERATIONAL ENERGY

Executive Summary

As a former pilot, when I think about the future fight – whenever that may come – I think about how we can provide our Airmen with the capabilities they need to defend the Nation and engage the enemy anywhere, anytime. I think about logistics and how we can reduce our operational risk and continue to deliver unwavering combat power to the warfighter. I think about what it will take to fly, fight, and win in a contested environment, possibly thousands of miles away, possibly over large expanses of water like the Pacific Ocean with few, if any, strategic outposts. I flew in that theater. I commanded crews flying over those vast oceans, and those distances will surely complicate the mission. No matter how complex the scenario, one thing is for certain: we will require operational energy to win; it's as simple as that.

Roberto Guerrero
Deputy Assistant Secretary of the U.S. Air Force, Operational Energy

Operational energy – mainly aviation fuel for the Air Force – is a strategic enabler and will determine the margin of victory in future conflict with a near-peer competitor. However, up until a few years ago, we were not giving it the consideration it warranted. During wargaming, we would not fully account for fuel to receivers, as if it got there by magic and not by tireless tankers in the sky. Since I began leading the Air Force Operational Energy office in 2014, we have integrated realistic operational energy scenarios into several joint wargames and played out how fuel logistics affect mission capability and outcome. Crucially, the lessons learned from these games helped us assess threats, identify capability gaps, and inform decision-making and investment priorities.

I'm proud of the tremendous progress we've made this year toward improving our efficiency, increasing readiness, and getting smart tools in the hands of Airmen. We launched the Mission Execution Excellence Program, a first of its kind incentive program to work with aircrews, maintainers, and logisticians to optimize flying operations. We began full implementation of the Operational Energy Savings Account, recovering millions of prior-year expired dollars in fuel cost savings from C-17 and C-5 operational efficiencies, which allowed us to fund multiple virtual reality aircraft maintenance training programs. We expanded our sustainment efforts, adding advanced detergents and foams into our engine wash programs, enabling increased performance and saving thousands of maintenance hours.

We passed critical milestones for the Blended Wing Body project, which will enable us to build and test a full-scale prototype over the next few years that promises to be 30% more efficient than traditional tube-and-wing designs with the same engines.

Additionally, we played a key role in developing the Department of the Air Force's Climate Action Plan published in October 2022, laying out ambitious goals to mitigate climate risk.

Finally, we updated our goals to better align with the current National Defense Strategy and our overall vision. While all our initiatives are connected to at least one of these five goals, there are several that span across multiple objectives, accomplishing several aspects of our mission at once. In this report, we tied each project to the goal it has the greatest impact on, but our efforts often benefit many areas of our portfolio simultaneously.

Our initiatives not only increase our air power and readiness, but they ensure a high return-on investment by streamlining operations and reducing fuel demand and costs, in turn decreasing greenhouse gas emissions. It's a win-win-win that just makes sense as we aim to *accelerate change…or lose.*

Thank you for your continued support along the way. We truly could not do it without you.

Sincerely,

Roberto Guerrero

MISSION

We seek to increase combat capability and mitigate operational risk through energy-informed solutions and technologies.

GOALS

1. **Fuel More Fight:** Improve Energy Intensity of Operations
2. **No Fuel, No Fight:** Understand & Manage Risk from Fuel Supply Chain
3. **Accelerate to Win:** Improve Planning Speed & Execution Effectiveness
4. **Data-Informed Decisions:** Enable Understanding of Operational Energy Use
5. **Engage & Inform Stakeholders:** Build Operational Energy-Informed Culture

GOAL 1: FUEL MORE FIGHT

Improve energy intensity of operations

Obj. 1.1 – Improve energy intensity of current operations
Obj. 1.2 – Advance transformative technologies to procurement

Goal 1 is one of our most far-reaching goals, touching nearly every aspect of what we do at Air Force Operational Energy. By improving the energy intensity of operations, we are increasing the efficiency of our aircraft, operations, and processes to achieve more capability per gallon of fuel consumed. In short, we're getting more 'bang for our buck' by using less fuel, enabling aircraft to fly farther and carry more, decreasing aircraft maintenance issues, and increasing readiness. We do this through a variety of ways including drag reduction technologies on our legacy aircraft, cargo optimization, engine sustainment, advanced platform designs, cultural change, and more.

MISSION EXECUTION EXCELLENCE PROGRAM

In 2022, we partnered with Air Mobility Command to launch MEEP, a pilot program to incentivize optimized flying on the largest fuel consumers in the Air Force, heavy mobility aircraft. MEEP encourages Airmen to increase their use of efficient flying 'best practices' through direct and indirect incentives and importantly, does not negatively impact mission and training requirements. The first phase of MEEP included four active-duty C-17 Globemaster III squadrons at Travis Air Force Base, California and Joint Base Charleston, South Carolina.

During the first year, units updated planning and operations processes resulting in a reduction in average shutdown fuel per sortie by over 12,000 pounds. Collectively, they are on-track to save over 1 million gallons of aviation fuel and $4 million in just one year. As a result, we provided over $2.45 million in rebates and award incentives to the participating wings, with the excess savings directed back to the Air Force to fund more initiatives.

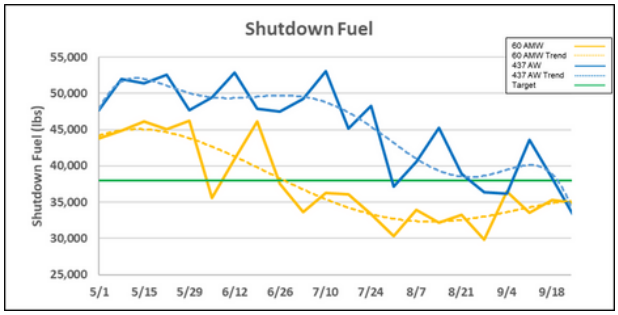


Chart displays the average shutdown fuel level for C-17 Globemaster III aircraft over time at Joint Base Charleston, South Carolina and Travis Air Force Base, California.

Furthermore, under the MEEP program we sponsored a ride-along program for flight managers in the 618th Air Operations Center to travel with aircrew and share lessons learned between flight planning and execution and increase trust between planners and operators.

We also provided a backup planning capability to flight managers to reduce risk and increase redundancy for flight planning capability.

Our initial estimates show that employing MEEP can improve energy intensity – or the mission effectiveness per gallon of fuel – by 3%. This is expected to increase the Air Force's capability and readiness while generating as much as $80 million per year in fuel cost savings that can be returned to the Air Force and participating units.

Aircraft Drag Reduction

We work closely with AFRL's Future Force Energy and Power office and the Air Vehicles Division on several advanced drag reduction initiatives, such as technologies to improve aircraft aerodynamics. We are funding the installation of aft body drag reduction devices on the full fleet of C-17, KC-135 Stratotanker, and C-130J Super Hercules aircraft. Additionally, we're funding the development and installation of other initiatives like vertical windshield wipers on the KC-135, engine pylon fairings on the C-17, optimization of flight control surface rigging on mobility aircraft, and active winglets on the KC-135. These initiatives are expected to reduce our fuel demand by tens of millions of gallons of fuel – adding up to an estimated $100 million in savings annually that we could reinvest back into force capability.

$100 MILLION ANNUALLY

Projected annual savings from aerodynamic efficiency technologies when fully implemented.

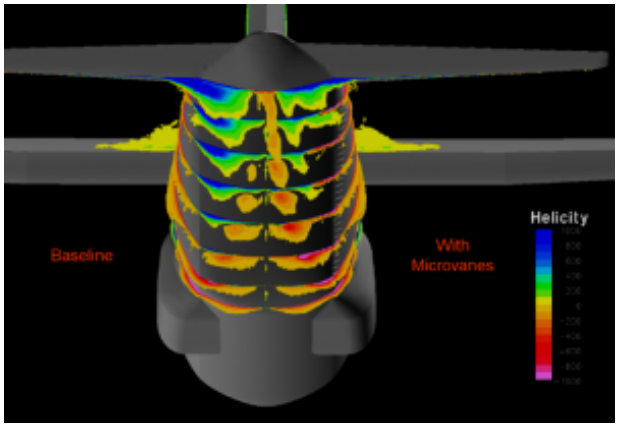


Image displays aerodynamic drag 'hot points' on the aft end of an aircraft, with and without drag reduction devices Microvanes (TM). (Image: Metro Aerospace)

Aircraft Engine Sustainment

We liaised with multiple defense industry and commercial aviation entities to identify industry best practices and technologies in aircraft sustainment that could potentially translate to the Air Force, ensuring overhauled legacy engines deliver optimized engine performance and efficiency. The commercial aviation industry is realizing fuel savings of 2-4% for the combined execution of these processes.

In 2022, we expanded our partnership with the Air Force Research Laboratory and the Air Force Life Cycle Management Center to certify compressor blade coatings and test compressor blade scanning technology and 21st century engine washing methods.

We sponsored an AFWERX Small Business Innovation Research program to test nucleated engine foam washing on Air Force Special Operations Command CV-22 Osprey aircraft and assess its ability to increase performance and improve sustainment methods.

The method resulted in an improvement to average time-on-wing from 149 to 251 hours, doubled on-station aircraft availability, increased mission capability rate from 36% to 64%, eliminated over 550 maintenance hours, and reduced the number of annual engine changes by five, saving approximately $4 million across the nucleated foam wash program. The results led to the expansion of the wash to the Air Force Special Operations Command AC-130 platforms, already demonstrating a 0.7% improvement in aircraft efficiency and will result in approximately $7 million per year in cost avoidance, if applied across the fleet.

Finally, we worked with the Air Force Research Laboratory to research and design new engine fan duct panels on the KC-135 to replace legacy fan ducts that require high levels of maintenance resulting in reduced performance. The redesigned panels increase airflow, resulting in a cost avoidance of $1 million per year that is anticipated to grow to greater than $5.5 million per year once applied across the fleet. Additionally, this saves the Air Force 1,700 maintenance hours per year and $1.85 million, expected to grow to $9 million.

READINESS

IMPROVED ENGINE PERFORMANCE

INCREASED EFFICIENCY

REDUCED MAINTENANCE

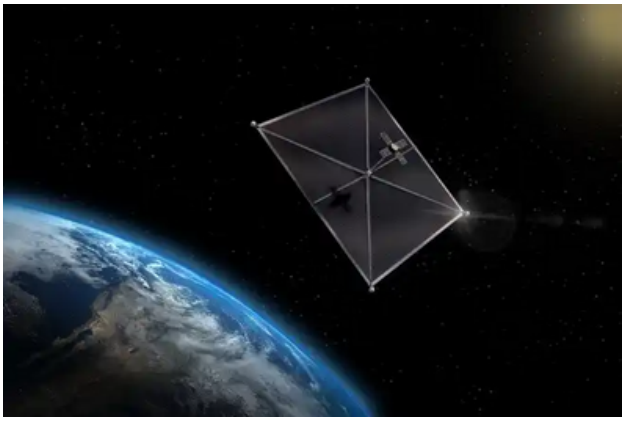
BLENDED WING BODY

We're also exploring transformative aircraft designs beyond our legacy aircraft such as the Blended Wind Body, which is expected to provide over 30% more aerodynamic efficiency than today's tankers, bombers, and cargo aircraft while enabling increased range, loiter time, and fuel offload capabilities. It's one of the single most impactful technology opportunities for future Air Force aircraft, both in terms of capability improvement and fuel demand reduction.

Boeing's X-48B Blended Wing Body technology demonstrator shows off its unique lines at sunset. (Image: Boeing)

While the BWB concept has existed for decades, the technologies required to execute many of its design aspects safely and effectively at scale, such as structural design and materials technology, are just now approaching maturity. Alongside the Air Force Research Laboratory, NASA, and Defense Innovation Unit, we're working with commercial aircraft manufacturers to develop and begin testing a full-scale demonstrator aircraft by 2027.

In the 2023 budget, Congress allocated $41.9M to fund this effort, and the Department of the Air Force has requested follow-on funding through FY26, totaling approximately $232M. This technology has the potential to save hundreds of millions of gallons of fuel over the long term if transitioned to the Air Force fleet.



The image depicts AFRL's Space Solar Power Incremental and Demonstrations Research Project beaming solar power from space to earth. (Image: Air Force Research Laboratory)

Space Solar Power

We're working with the Air Force Research Laboratory, the Naval Research Laboratory, and the commercial industry on the Space Solar Power Incremental Demonstrations and Research Project, an initiative to develop technology to harvest solar energy in space via photovoltaic cells, and wirelessly transmit it back to earth as radio frequency beams. A receiving antenna would then convert the beam into usable power anywhere in the world. This capability could help reduce reliance on petroleum-based fuels and vulnerable supply lines and enable greater access to electricity for forward operating bases. While there are several challenges to overcome, this project aims to develop the technologies required to make it a reality in the future.

Climate Mitigation

Optimizing our fuel use through modern technologies and processes not only improves our capability and readiness – but also reduces greenhouse gas emissions that contribute to global warming and recurrent severe weather events. Our installations, and the communities where our Airmen live and work, have sustained severe damage, weakening our readiness. Disruptions to our logistics and supply chains have affected our operations, leaving us increasingly vulnerable.

In 2022, we finalized climate objectives and key results as part of the Department of the Air Force Climate Action Plan, published in October. As outlined in this report, we're targeting several areas to limit our fuel use and optimize operations.

Objective 3.1: Improve Operational Energy Intensity

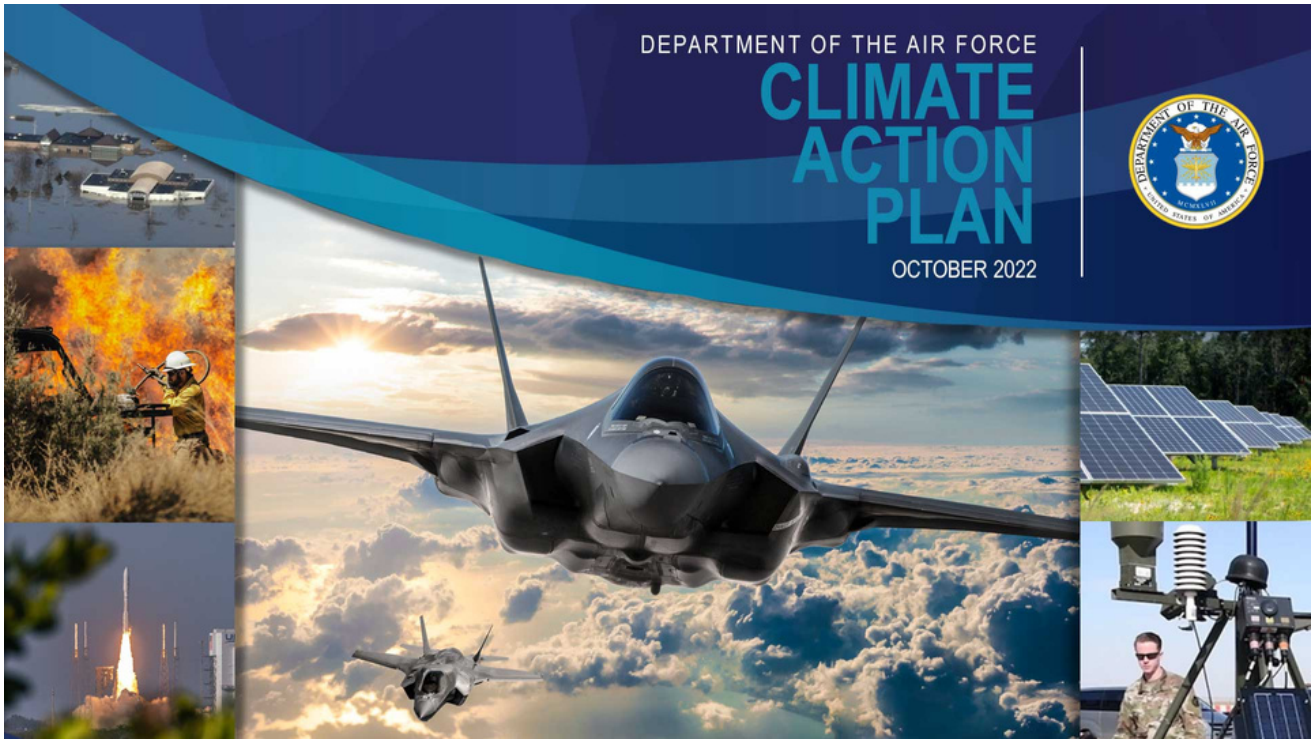
- Improve operational energy intensity of Air Force flying missions by 5% by 2027 and 7.5% by 2032
- Develop and test a full-scale blended wing body prototype by 2027

Objective 3.2: Adopt Alternative Energy Sources

Key Result 3.2.1
Complete successful pilot of drop-in compatible sustainable aviation fuel at two operational Air Force locations by FY26

Once these efforts are fully implemented, they're estimated to reduce our emissions by a combined 3.7% in 5 years – or approximately 67 million gallons of fuel annually. However, to meet the 5% and 7.5% reduction goals laid out in the Plan, the Department of the Air Force will need additional investment in projects like advanced winglets, compressor blade coatings, compressor blade scanning, and improved engine wash technology, which will provide significant reduction in drag and greenhouse gas emissions, as well as increase our combat capability.

Furthermore, in 2022 the Department of the Air Force joined the Global Air Forces Climate Change Collaboration, a group of over 35 partner nations and allies, to share best practices on climate mitigation and adaptation in operations. Through collaborative working groups, we're developing the foundational strategy and organizational structure to integrate climate and energy considerations into operations and training across air forces around the world.



GOAL 2: NO FUEL, NO FIGHT

Understand & Manage Risk from the Fuel Supply Chain

Obj. 2.1 – Support in-air fuel availability for training & operations
Obj. 2.2 – Quantify risk of contested logistics for planning integration

Without fuel, we cannot accomplish our mission to fly, fight, and win. It's a necessary component of nearly every aspect of operations – yet it often is a target for enemy attacks and poses a serious threat to the warfighter. Our goal is to better understand and integrate energy and fuel logistics into wargaming, training, and planning to manage and mitigate this risk where possible, especially in the "last mile" of fuel delivery from Air Force aerial refueling assets. Improving tanker aircraft availability and performance, especially in ways that deliver more fuel to receivers through improved efficiency or scheduling, will reduce risk to operations from contested logistics in peer or near-peer environments.

TANKER READINESS

Several initiatives improve tanker aircraft availability or performance in operations to maximize support for receivers. In 2022, we funded upgrades to the tanker planning tool Jigsaw, which streamlines aerial refueling schedules, reducing mission planning time from hours to minutes and improving tanker asset utilization. With the addition of an auto-planning feature, scheduling efficiency is expected to increase by over 10% - equivalent to adding five additional tankers to an average CENTCOM Air Tasking Order. These efficiencies enable Central Command to maintain the same combat sortie rate while decreasing operational risk and fuel use by an estimated $31 million per year.

20% MORE CAPABILITY

10% MORE EFFICIENCY

Analysis shows that increasing efficiency by 10% results in a 20% improvement to capability and readiness.

We also continued to fund the expansion of Magellan, a collaborative and secure software app for mobility asset allocation, which replaces antiquated manual processes. This tool has seen an improvement in the missions that Air Mobility Command can support, extending a limited mobility fleet with better planning. We supported upgrades to its functionality and the development of new features, integrating it with the current programs of record and the Air Force Generation Model. It's estimated to reduce fuel demand costs by approximately $14 million annually.

Finally, we led a multi-organization effort to author the Department of the Air Force's first, veritable Energy Supportability Analysis (ESA). ESAs established Energy-Key Performance Parameters as part of the weapon system capability development and acquisition process. For a given aircraft, ESAs primarily inform platform energy efficiency and power requirements, as well as necessary support changes, such as fuels infrastructure, fuels equipment, and aerial refueling postures, to achieve mission success. For example, the KC-Y ESA explored performance parameters and requirements for energy, readiness, fuel infrastructure, and fuel distribution to inform acquisition program decisions for KC-Y, as well as more generally underlining air operations challenges throughout the Western Pacific.

Energy-Informed Wargaming

Alongside our Air Force and DoD partners, we have successfully integrated comprehensive fuel logistics and supply chain modeling into joint wargames to better assess the logistical supportability of operations – from force deployment and sustainment to recovery from force attrition and logistics network disruption. Our work has introduced more realistic operational energy scenarios into gameplay and provides senior leadership with greater visibility for informed decision-making, strategic postures, acquisitions, and force designs.

Air Force Operational Energy actively participates in the planning, design, and roleplay of the Air Force's Title 10 Wargame Series Global Engagement as well as the Joint Forces Energy Wargame and the Joint Staff Directorate of Logistics Advancing Globally Integrated Logistics Effort.

In 2022, we partnered with the Secretary of the Air Force's Studies and Analysis team on Generating Sorties Under Attack, exploring spoke and hub operations in the Pacific to better quantify the requirements and associated risks of employing Agile Combat Employment.

Wargame Participation:

Global Engagement

Long Duration Logistics Wargame

Advancing Globally Integrated Logistics Effort

Futures Wargame

Joint Forces Energy Wargame

Pacific Energy Distribution and Critical Infrastructure Wargame

Aviation Alternative Fuels

The Department is continually exploring alternative energy sources that could lessen our reliance on fossil fuels and provide redundancy in the face of contested logistics. We engage with our defense partners as well as commercial stakeholders to monitor alternative fuel production, pricing, and commercial use to help determine the possible applicability for the Air Force.

In 2022, we endorsed the Chief of Staff of the Air Force's Blue Horizons Project FIERCE (Forward Integrated Energy Resourcing for Contested Environments) to create and test a fully synthetic net-carbon neutral "drop-in" replacement jet fuel from captured carbon dioxide and water. The project successfully demonstrated the capability, creating the first fuel made entirely of carbon dioxide emissions that matches the properties and performance of Jet A-1, and completed flight testing of the fuel in July 2022. Next, the fuels must be fully certified by the American Society for Testing and Materials and approved for use on DoD weapon systems.

Additionally, we are exploring the feasibility of commercially produced dual-fuel turbine engines, compatible with both liquid natural gas (LNG) and petroleum-based aviation fuel. This technology could maximize battlespace fuel options, distribute logistics risk, complicate enemy targeting of fuel storage and distribution networks, and enhance aircraft thermal management capabilities. Furthermore, because LNG contains more energy per unit mass, LNG-powered mobility and tanker aircraft provide opportunities for increased payload and fuel offload capabilities.

GOAL 3: ACCELERATE TO WIN

Improve Planning Speed & Execution Effectiveness

Obj. 3.1 – Integrate contested logistics in JADC2
Obj. 3.2 – Increase speed of logistics planning & processes

Not only are we introducing technologies and processes to optimize aircraft operations, but we're also streamlining how we plan for and execute missions through advanced software and scheduling tools. Aligned with the DoD-led Joint All-Domain and Control (JADC2) effort, these initiatives allow us to better connect warfighters to the data and information they need to win, seamlessly and securely, bolstering our decision advantage.

The image displays a fictional scenario in the mobility tanker allocation tool Magellan. (Image: 581st Software Development Sq.)

MISSION PLANNING & EXECUTION OPTIMIZATION

In 2022, we continued to partner with Air Force organizations to fund and develop software tools that support mission planning and optimization. We worked with the Air Force Life Cycle Management Center's Digital Directorate to develop and fund PortfolioX, a team of developers building a suite of applications for the Kessel Run All Domain Operating System (KRADOS) to improve the Air Tasking Order planning cycle.

PortfolioX will help optimize air logistics, track fuel use, and prevent an estimated $1.4 million in unnecessary fuel costs. We also worked with the Program Executive Office Business Enterprise Systems to fund the Aviation Resource Management System, helping to accelerate its development and modernization as the program of record for aircrew currency requirements.

Alongside the Air Mobility Command Commander's Initiative Group and the 581st Software Engineering Squadron, we helped develop the Command & Control Decision Delivery (C2D2) web application, a tool to share command and control decisions from any echelon to the Mobility Air Forces. Additionally, we purchased 18,000 licenses for Mattermost users in the Mobility Air Forces community providing a vital bridge to the MAF's operational capability efforts for asynchronous and automated communications.

Finally, we supported and funded the expansion of Puckboard, a real-time collaborative scheduling engine which saw tremendous growth this year thanks to the development team at Tron AF, in affiliation with Aloha Spark and Palmetto Spark.

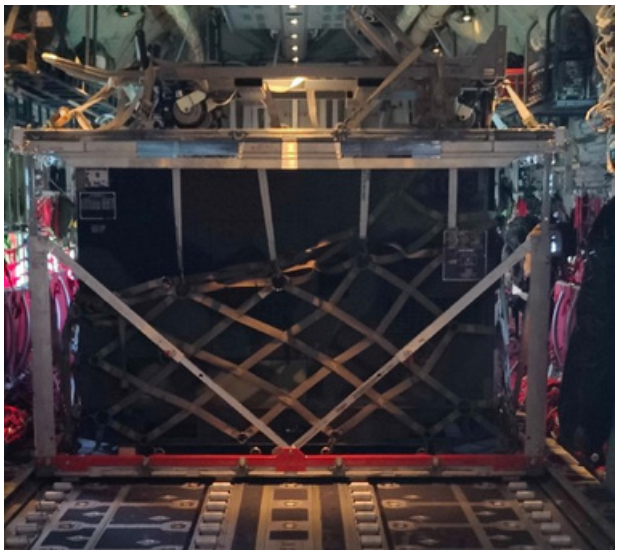
Distributing schedule updates to aircrew can now be done in real-time, available anywhere on the globe, on or off the DoD network. This dramatically accelerates the mission planning process and is optimizing our training, readiness, and operations for C-17s and other mobility assets, with an estimated $4 million in fuel cost avoidance annually.

Cargo Optimization

We're partnering with several Air Force and DoD organizations to improve cargo loading and move toward the Aerial Port of the Future. In 2022, we invested in foundational automated air cargo management tools such as Cerebus, a tool that optimizes air cargo freight movements and provides real-time cargo status and location notifications. We provided funding for Apollo, a program that provides next generation asset reporting and workload data, offering near-real-time display of facilities, equipment, and personnel. We also funded Merlin, a program to automate port-to-port and diplomatic clearance requests with digital documentation.

We worked with the Air Force Institute of Technology to research 3-D cargo scanning to inform planning and enroute visibility and the Air Force Research Laboratory to develop digital models and optimization prototypes for aerial ports. Finally, we partnered with the 581st Software Engineering Squadron to develop Levels, a weight-and-balance application designed to accelerate load planning on the C-17, optimize center-of-gravity on airlift missions, and connect to Mobility Air Forces Command and Control systems of record. Together, these cargo optimization initiatives are estimated to save $9 million annually in fuel costs.

Finally, we worked with the Air Force Research Laboratory to develop and test a prototype for the Vertical Pallet Stacker, a mobile structure designed to utilize more vertical space in mobility aircraft cargo compartments, allowing for more efficient use of cargo space and requiring fewer sorties to transport cargo – thus decreasing overall fuel use and increasing availability of aircraft with an estimated fuel savings of nearly $2 million each year.



(Above) The Vertical Pallet Stacker demonstrates its capability to stack cargo vertically on an aircraft. (Image: Air Force) (Below) The image shows the airlift planning tool HONE optimized with quantum computing to improve throughput, populated with notional data. The Air Force sponsored the project with SavantX to optimize cargo planning. (Image: SavantX)

Goal 4: Data-Informed Decisions

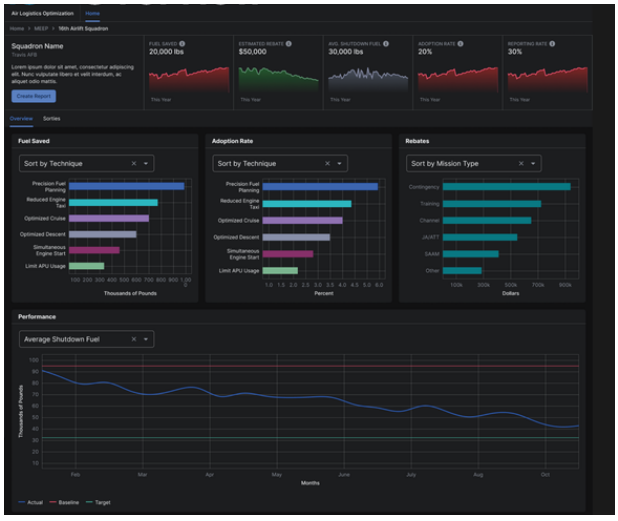
Enable Understanding of Operational Energy Use

Obj. 4.1 – Collect real-time metrics on 95% of fuel use

Data Collection & Analysis

Comprehensive, trustworthy data is essential to analyze flight operations. The Operational Energy Data Collection Strategy facilitated greater visibility into Air Force fuel use and uncovered numerous opportunities to enhance operations through the efficient application of resources.

Utilizing modern tools and software, we established a pipeline to store and analyze flight and fuel use data from multiple sources, enabling us to collaborate with stakeholders. The shared environment allows us to better analyze operations, optimize aircraft fuel and load planning, and identify best practices to maximize aircraft reach and readiness.



The image shows a mock display of the C3.ai Data Integration Network for Operational Energy, using notional data to key performance indicators. (Image: C3.ai)

In 2022, we partnered with the Defense Innovation Unit to expand the data pipeline and increase the transmittal, processing, and visualization of high-fidelity flight recorder data files to enable insights into enterprise fuel use. The prototype uses advanced analytics to ingest historical and near-real time data from mobility aircraft at scale. By matching mission details to aircraft performance, the platform will discover inferences that will shape enterprise-level decisions for future fuel usage. As of December 2022, we have access to approximately 62% of sortie-level aircraft fuel use data across all airframes, and we continue to grow our analysis capabilities to inform decision making.

In 2020, we used an established wargaming model to show that legacy air refueling platforms with a 10% efficiency increase are 20% more effective on the battlefield, delivering more fuel to receivers with fewer sorties. Since then, we have expanded access to operational simulations that will allow us to evaluate fuel efficiency improvements in the context of their impact on the battlefield, with a clear link to warfighter value. These simulations allow us to explore the value of investments as they relate to combat capability directly and can inform resourcing and program management decisions across the enterprise.

Goal 5: Engage & Inform

Build Operational Energy-Informed Culture

Obj. 5.1 – Execute communications strategy to inform stakeholders and increase understanding across the DAF, Congress, & industry

Obj. 5.2 – Leverage academic research talent and integrate operational energy principles into Air Force curricula

Through our strategic engagement efforts, including enhanced training and education, incentive programs, leadership engagements, targeted content, and cultural change initiatives, we are building a community of informed Airmen that can champion our initiatives and continue to drive toward a more ready and resilient force.

Education & Training

In 2022, our team strengthened our innovation research portfolio and explored new ways to share educational content. Our main successes stemmed from research partnerships. Air Force research partners include Air Force Institute of Technology, Air Force Study of Air Mobility, U.S. Air Force Academy, Blue Horizons, and Air Command and Staff College. Additionally, we supported an Education with Industry Fellow at Amazon AIR to research building an energy-aware culture, which was presented to Air Force senior leadership. We also continued partnering with non-Air Force universities through two National Security Innovation Network programs: Hacking for Defense and Tech Squad. These projects explored sustainable aviation fuel options for the Air Force and improved our existing supply chain risk model. Other partnerships included projects with the University of California at Berkeley, Duke University, and Naval Postgraduate School to address various aspects of the supply chain model.

Student pilots train on a virtual reality flight simulator. (Image: Air Force)

Additionally, we funded over $13 million for augmented reality /virtual reality training systems for Air Mobility Command and Air Force Special Operations Command (AFSOC). At AFSOC alone, these initiatives have projected savings of $8 million annually in fuel and manpower, with a 50% reduction in aircraft downtime for maintenance training. Annually, this will return 20k personnel hours back to the flight line while reducing maintainer upgrade time by an average of 30-50%.

Strategic Communications

We continued to enhance and implement our communications and engagement strategy, aligned with the National Defense Strategy and Air Force initiatives. Through multi-channel communications and content development, media relations, awareness campaigns, leadership engagement, and targeted and consistent messaging, we helped inform Airmen, Air Force leadership, and Congress about smart energy solutions and their ability to maximize combat capability and mission readiness.

Finally, we have experienced liaisons with subject matter expertise at several of the Major Commands (MAJCOMs) to provide day-to-day direct communication and coordination with MAJCOM leadership and advocate for operational energy initiatives. Locations include Air Education Training Command at Joint Base San Antonio, Texas, Air Force Special Operations Command at Hurlburt Field, Florida, Air Mobility Command and the Tanker Aircraft Control Center at Scott Air Force Base, Illinois, and Pacific Air Forces at Joint Base Pearl Harbor-Hickam, Hawaii.

CLOSING

Innovation only happens when our Airmen are engaged and given the knowledge, training, and authority to succeed. At Air Force Operational Energy, we strive to follow Chief of Staff General Charles Q. Brown's directive to "accelerate change ... or lose" by introducing transformative 21st century technologies and processes to Airmen.

> **"Good enough today will *fail* tomorrow."**
>
> *Chief of Staff of the Air Force, General Charles Q. Brown*

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