

Department of the Air Force

# CLIMATE ACTION PLAN

October 2022



PLEASE CITE THIS CLIMATE ACTION PLAN AS:

Department of the Air Force, Office of the Assistant Secretary for Energy, Installations, and Environment.  
October 2022. Department of the Air Force Climate Action Plan. Washington, DC.

*Cover photo descriptions:*

*Flooding at Offutt Air Force Base*

*Extensive flooding from the Missouri River in March 2019 forced Offutt Air Force Base, Nebraska, to evacuate nine aircraft. Floodwaters contaminated with raw sewage covered about one-third of the base, including 3,000 feet of runway. About 3,200 personnel lost their workspaces and 137 facilities were damaged, 60 of which were deemed unsalvageable. The re-build effort provides the opportunity to design a new layout of campuses that groups similar missions together. (U.S. Air Force photo by Tech Sgt Rachelle Blake)*

*Prescribed Burning at Edwards Air Force Base*

*Crews conduct prescribed burns September 2019 at Edwards Air Force Base, California. The prescribed burns reduce wildfire risk by removing old, dry fuels susceptible to wildfire. The burns also support habitat restoration by thinning out an invasive grass that competes with native species for natural resources. (U. S. Air Force photo by Harley Huntington)*

*Launch at Cape Canaveral Space Force Station*

*A United Launch Alliance Atlas V rocket carrying the GOES-T spacecraft for the National Oceanic and Atmospheric Administration and NASA lifts off from Space Launch Complex-41 at Cape Canaveral Space Force Station, Florida, March 1, 2022. GOES-T will provide NASA and NOAA with continuous imagery and atmospheric measurements of Earth's Western Hemisphere, lightning detection and mapping, solar imaging and space weather monitoring. (U.S. Space Force photo by Senior Airman Thomas Sjoberg)*

*F-35A*

*The F-35A is the U.S. Air Force's latest fifth-generation fighter. With its aerodynamic performance and advanced integrated avionics, the F-35A will provide next-generation stealth, enhanced situational awareness, and reduced vulnerability for the United States and allied nations. (Getty Images)*

## CALLING THE DEPARTMENT OF THE AIR FORCE TO ACTION



Climate change is reshaping the increasingly complex global security environment and the Department of the Air Force must adapt and respond to that threat.

Make no mistake – the department's mission remains to fly, fight, and win, anytime and anywhere. We are focused on modernization and improving our operational posture relative to our pacing challenge: China. We remain ready to respond and achieve air and space dominance when and where the nation needs us. Our mission remains unchanged, but we recognize that the world is facing ongoing and accelerating climate change and we must be prepared to respond, fight, and win in this constantly changing world.

Extreme weather and environmental conditions are already imposing high costs on Department of the Air Force installations and operational missions, while simultaneously posing new risks to our ability to train and operate effectively. In recent years, we have seen Tyndall Air Force Base, Florida, and many of its fighter aircraft devastated by Hurricane Michael, a third of Offutt

Air Force Base, Nebraska, flooded as the Missouri River overwhelmed levees, and multiple installations across the United States threatened by advancing wildfires. Extreme heat and humidity can also challenge our deployed forces' operational readiness. Environmental changes in the Arctic have led to increased adversary access and activity in the region, driving us to publish the Department of the Air Force Arctic Strategy in 2020.

We must prioritize air and space dominance in a security environment shaped by a changing climate, yet also recognize and reduce the department's role in contributing to climate change. Department capabilities that provide air and space dominance and global reach are fed by a steady diet of fossil fuel, representing the bulk of the Defense Department's carbon footprint and a continual burden on our changing climate. We will, therefore, demand increased efficiency in our warfighting systems and installations as well as strive to reduce our impact on the environment, all while enhancing our warfighting capabilities. Reducing our energy demand both enhances our mission capability and mitigates contested logistics risk.

The department will address the challenges and risks presented by climate change through the implementation of three climate priorities: (1) Maintain air and space dominance in the face of climate risks; (2) Make climate-informed decisions; and (3) Optimize energy use and pursue alternative energy sources.

We cannot delay in addressing the impacts of climate change. Alongside industry, government, and international allies and partners, the Department of the Air Force will invest in critical capabilities and technologies to modernize the force to be more ready and resilient. Our investments will target infrastructure, weapon systems, technology, and equipment that are demonstrably more efficient and combat-credible today to improve Air Force and Space Force warfighting capability tomorrow.

Every Airman and Guardian has a role in helping the department succeed in adapting to and overcoming the effects of climate change to ensure mission success across the force and across the globe. This Climate Action Plan is your roadmap to combat climate change; more than that, it is your call to action.

A handwritten signature in black ink, appearing to read "Frank Kendall".

Frank Kendall  
Secretary of the Air Force



## OVERVIEW

**Climate change is an existential threat to our nation's security, and the Department of Defense must act swiftly and boldly to take on this challenge and prepare for damage that cannot be avoided.**

**There is little about what the Department does to defend the American people that is not affected by climate change. It is a national security issue, and we must treat it as such.**

*Secretary Of Defense Lloyd J. Austin III,  
October 7, 2021*

### Why Climate Change Matters to the Department of the Air Force

Climate change matters first and foremost to the Department of the Air Force because it impacts our mission capabilities and those impacts are projected to increase over time. The department is composed of two military services—the Air Force and the Space Force. While both services have distinct missions, the role of both services is consistent: to deter conflict and if necessary, defeat adversaries across the air and space domains. Climate change has introduced acute challenges to achieving air and space dominance; climate change impacts our ability to maintain operational readiness, access strategic locations globally, and execute the operational mission.



March 2019 flooding at Offutt Air Force Base, Nebraska, limited runway use, even after floodwaters receded, due to inspection requirements. The new STRATCOM headquarters building, completed earlier in 2019, was built on higher ground, with barriers to reduce flood risk, and thus was not affected by the flooding. (Department of Air Force photo by Tech Sgt Rachelle Blake)

## Impacts to Installations and Operational Capabilities

Increasing temperatures, changing precipitation patterns, and more frequent, severe weather conditions driven by climate change pose increasing risks to our installations and operational readiness. We cannot launch or recover aircraft on a flooded runway, nor can we operate from installations devastated by hurricanes and wildfires. In the Arctic, thawing permafrost affects infrastructure across the region, buckling roads and destabilizing building foundations. Melting sea ice accelerates the rate of coastal erosion, further threatening department infrastructure. With the Arctic region warming more quickly than any other parts of the globe, the region has become increasingly more accessible to strategic competitors, creating a demand signal for our response. Across the globe, extreme heat and humidity are a detriment to our ability to execute operations including impacting aircraft performance and payload capacity and directly threatening the health of deployed Airmen and Guardians. We must be able to effectively operate and dominate in evolving environments. Our bases are our power projection platforms and as those bases are increasingly impacted by the effects of climate change, we must adapt to ensure we can execute the mission on behalf of the nation.

## Expanding Mission Requirements

Climate change is aggravating geopolitical unrest and acting as a threat multiplier, which is leading to new and expanded mission requirements for the department. Food insecurity, water scarcity, economic dislocation, and natural disasters perpetuate regional instability and test the capacity of governments around the world to protect their citizens. Violent extremist organizations take advantage of these conditions to increase their

influence and power. We may be called upon to respond to increasing numbers of natural disasters or to spiraling regional conflicts driven by instability.



*Airmen from the 621st Contingency Response Wing at Joint Base McGuire-Dix-Lakehurst, New Jersey, prepare emergency equipment for immediate response to Hurricane Irene at the CRW's Global Reach Deployment Center in August 2011. The roughly 600 Airmen of the CRW specialize in creating aerial port and command-and-control facilities in damaged or hostile environments. Previous missions have included humanitarian responses to Haiti, Pakistan, and Japan in the aftermath of earthquakes, floods, and tsunami in addition to Hurricanes Ike, Rita, Gustav and Katrina. (Department of Air Force photo by Tech Sgt Edward Gyokeres)*

## Contribution to Global Greenhouse Gas Emissions

The department recognizes that we are contributing to global climate change. The department is responsible for the largest portion of Department of Defense's (DoD) greenhouse gas emissions. While the Air Force fulfills much-needed global mobility and transportation requirements for the DoD, these same capabilities drive a huge demand for fuel. The increased risks driven by climate change cannot be addressed by emission reductions in the Air Force alone, but the Department of the Air Force will be part of the solution. Improving energy efficiency and deploying advanced energy technologies will



A KC-10 Extender, assigned to the 9th Air Refueling Squadron, refuels an F-16C Fighting Falcon Jan. 28, 2021, over California. The F-16s are assigned to the 177th Fighter Wing at the Atlantic City Air National Guard Base, New Jersey. (Department of Air Force photo by Tech Sgt Traci Keller)

not only decrease emissions but will help mitigate combat risk and increase operational capability.

## Department of the Air Force Climate Priorities

We are focused on building enduring advantages across the department. Combating the effects of climate change will enhance the force's resilience and agility, enabling us to field a combat-credible force that can train, fight, and win in an increasingly complex strategic environment. The department will address the challenges and risks presented by climate change through the implementation of three climate priorities: (1) Maintain air and space dominance in the face of climate risks; (2) Make climate-informed decisions; and (3) Optimize energy use and pursue alternative energy sources.

### CLIMATE ACTION PLAN GOAL

The department is resilient to the effects of climate change and preserves a combat-credible force that can compete, deter, and win against pacing threats.

## 1. Maintain Air and Space Dominance in the Face of Climate Risks

Climate change acutely challenges the department's ability to achieve air and space dominance because climate change impacts our ability to maintain operational readiness, access strategic locations globally, and execute the operational mission. The department will ensure installation resiliency and adaptability in the face of challenges ranging from climate change to pacing threats.



Planning charrettes held at Tyndall Air Force Base, Florida, in March 2019 focused on designing an Installation of the Future, resilient and right-sized. (Department of the Air Force photo by Amy Vandever)

## 2. Make Climate-Informed Decisions

To institute enduring advantages while combating the effects of climate change, we must fundamentally shift the way the department thinks, prepares, and acts. As we execute the department's priorities through our planning documents, our actions, and across our acquisitions, we must be deliberate in including climate risks and security

implications. How we prepare our personnel, utilize data, and develop strategic plans, requirements, and wargames are foundational to the department. We must seamlessly integrate climate and operational considerations throughout our processes, plans, and decisions to develop and field a more agile, resilient, and responsible combat-credible force for today and into the future.

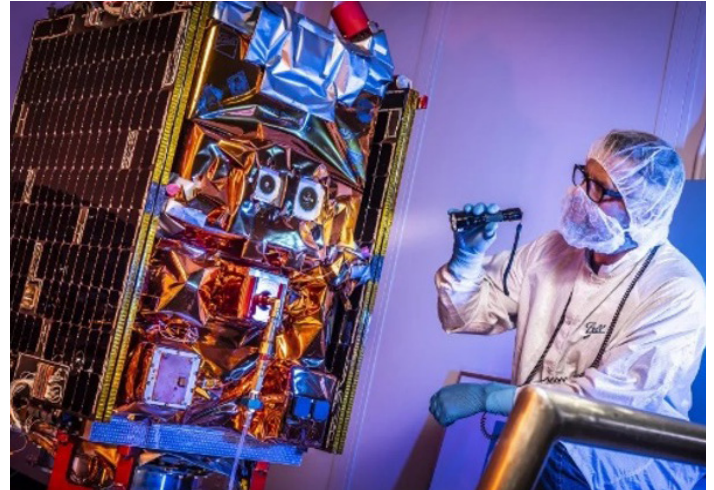


Air Force senior leaders participating in Operation Uggianaqtuq, an Air Force Arctic Security Expedition, fly on a helicopter before landing on a glacier near Illulissat, Greenland in September 2017. The senior leaders were in Greenland, Canada, and Alaska to better understand the challenges of operating in the Arctic and to build relationships with allies and partner nations. (Department of the Air Force photo by Tech Sgt Daniel DeCook)



### 3. Optimize Energy Use and Pursue Alternative Energy Sources

The Department of the Air Force aims to reduce the fossil fuel demand of our current and future weapon systems to enhance our ability to operate in contested environments, increase our readiness, reduce our logistics tail, and lower our greenhouse gas emissions. Through our planned initiatives, we will expand the operational range of our weapon systems and our ability to project power and support operations globally while simultaneously reducing greenhouse gas emissions. The department is pursuing alternative energy sources, including piloting projects that produce fewer greenhouse gas emissions and assessing their viability to support installation energy efficiency enterprise-wide.



*An engineer checks a small satellite platform powered by environmentally friendly propellant developed by the U.S. Air Force Research Lab and launched aboard a SpaceX Falcon Heavy rocket. (Photo courtesy of Ball Aerospace)*



*This array of solar panels at Moody Air Force Base, Georgia, saves \$700,000 annually. (Department of the Air Force photo by Airman 1st Class Megan Estrada)*

## DEPARTMENT OF THE AIR FORCE CLIMATE PRIORITIES AND KEY RESULTS

The department recognizes that addressing climate change is not a single, stand-alone effort managed by one program office; climate change affects the entirety of the department's enterprise. Climate policies and actions must be incorporated across the Air Force and Space Force, and continually progress as technology advances, as our understanding of climate change impacts deepens, and as our mission requirements evolve. The Department of the Air Force will provide oversight, monitoring, and implementation direction for our climate efforts through the Senior Leader Climate Forum, comprising the Offices of the Secretariat, Deputy Chiefs of the Air Staff, and Deputy Chiefs of Space Operations, and chaired by the Assistant Secretary of the Air Force for Energy, Installations, and Environment.

Each of the three priority sections below concludes with a summary of objectives and key results. The key results describe the department's future state.

### PRIORITY 1 – MAINTAIN AIR AND SPACE DOMINANCE IN THE FACE OF CLIMATE RISKS

Changes in the climate globally have introduced new and complex challenges to Air and Space Force

bases, which are critical to the department's ability to train, deploy, and operate anytime and anywhere. Resilient installations enable the accomplishment of all our missions, whether the department is conducting: fifth-generation fighter training; strategic missile warning; cargo, fuel or personnel movements; global intelligence, surveillance and reconnaissance; or conventional or strategic precision strike attacks. The department must also protect the health and wellness of our Airmen, Guardians, and their families, and maintain the readiness of our forces by providing safe and healthy communities at our installations worldwide.



*A member of the 17th Civil Engineering Squadron enhances the safety of travel routes by clearing snow at Goodfellow Air Force Base, Texas, February 15, 2021. The 17th CES adapted and overcame the challenges of record-breaking snowfall with no proper removal equipment in order to continue the mission. (Courtesy photo)*

#### MAINTAIN AIR AND SPACE DOMINANCE IN THE FACE OF CLIMATE RISKS

##### GOAL

- Department installations are resilient to the effects of climate change to sustain a combat-credible force and enable global power projection.
- Decreased department contribution to future climate risk via the reduction of greenhouse gas emissions.

The department operates 175 Air Force and Space Force installations across the globe consisting of 83 Active Duty, 83 Air National Guard, and 9 Air Force Reserve installations. The department is no stranger to the impacts of climate change on its installations. Permafrost thaw presents risks to critical infrastructure at Alaskan facilities. Coastal erosion encroaches on facilities and land at coastal installations. Heavy precipitation overwhelms drainage systems and causes temporary airfield

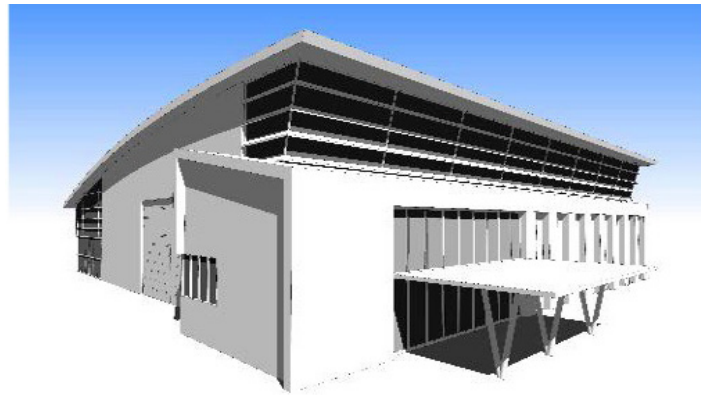


closures. Incidents of a weakening polar vortex shift the effects of winter storms as far south as our bases in Texas, resulting in power outages and damaged utility infrastructure.

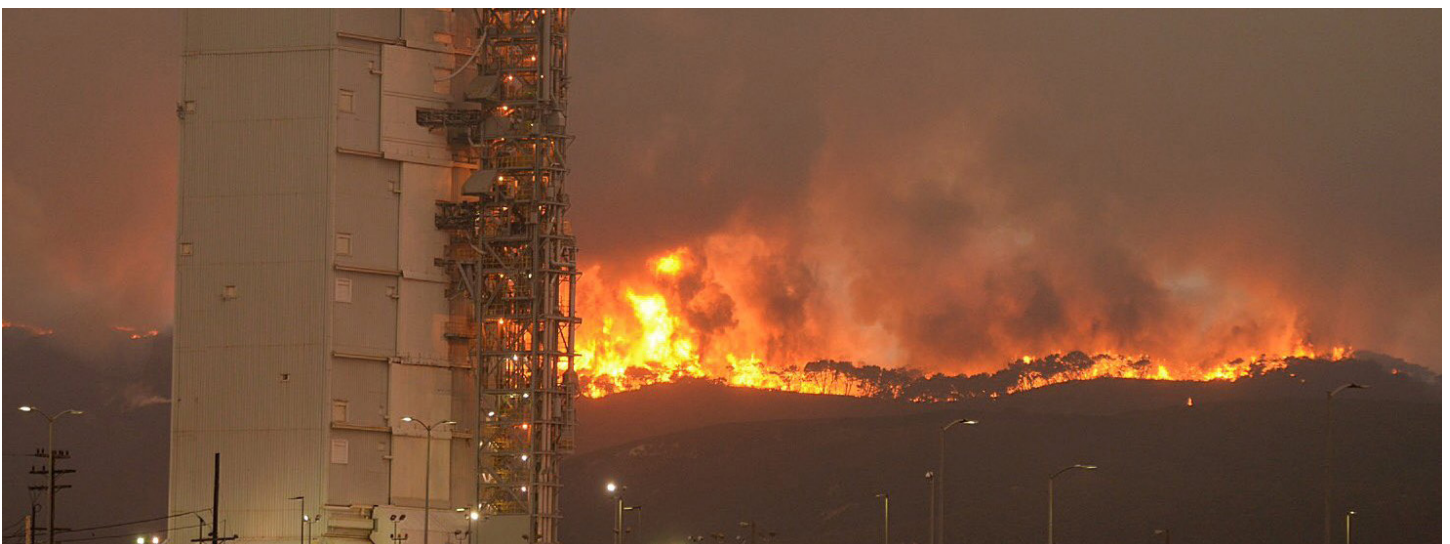
Increased frequency and longevity of drought strains natural water systems and, when combined with increased wind, spur the rapid spread of wildfires. These wildfires threaten the health and safety of department personnel, reduce visibility and our ability to perform testing and training, threaten department infrastructure, and impede the delivery of key resources, such as power and water.

Though wildfires are integral to natural ecological processes, they can also threaten installations and military communities, and disrupt operational missions and readiness. In 2016, the Canyon Wildfire prompted evacuations and a rocket launch delay at Vandenberg Air Force Base (now Space Force Base), California, diverting critical resources and personnel to execute firefighting activities. The Canyon Wildfire alone cost \$17.5 million to extinguish and \$45 million to accomplish a full recovery.

We are also reckoning with how the department consumes and generates energy on our installations. The department's reliance on fossil fuels is expensive and increases future climate risk through the production of greenhouse gases that contribute to climate instability. We must rethink how we can make our installations more resilient to the effects of climate change, while simultaneously reducing our impact on the environment through energy efficiency measures.



*A building concept for Tyndall Air Force Base contains features designed to withstand more frequent and intense hurricane forces following significant damage from Hurricane Michael in 2018. (Department of the Air Force photo)*



*Flames burn behind the Atlas 5 rocket pad at Vandenberg Air Force Base (now Space Force Base), California, in September 2016. The Canyon Wildfire postponed a launch mission, caused power outages, and destroyed some base power and communications infrastructure. (Photo courtesy of Santa Barbara County Fire Department)*

To prevent our critical infrastructure from failing in increasingly extreme conditions, the department must focus on retooling bases and making structures, power grids, fuel distribution systems, and water lines more resistant to these climate-driven impacts. We are using wargames to assess the resiliency of bases and identify vulnerable supply chains, and researching cutting-edge technologies that enable operations off the grid if power fails. The department will also continue to develop secure, digitally integrated infrastructure to minimize vulnerabilities and interruptions to our facility control systems, including power distribution and airfield lighting.

Initiatives are underway to assess climate effects, modernize infrastructure, and adapt installations to minimize impacts from future climate threats.

Updating current and future department policies, plans, and projects to integrate climate considerations provides an opportunity to address the evolving security environment and develop more resilient installations. Planning tools, such as the *Severe Weather and Climate Hazard Screening and Risk Assessment Playbook* and *Installation Energy Plans*, provide opportunities to baseline extreme weather and climatic conditions, assess energy and water requirements, and develop appropriate strategies to minimize future climate impacts on our infrastructure. Energy Resilience Readiness Exercises further assess and verify an installation's ability to operate despite power outages, thereby increasing installation resilience to man-made and climate-driven disruptions. These activities will inform future investments that protect installations, ensure mission execution, support installation security, and facilitate installation recovery from future climate impacts.



Members of MacDill Air Force Base and the local community build oyster reefs at MacDill Air Force Base, Florida, March 30, 2018. MacDill's eastern shoreline is prone to erosion, however oyster reefs aid in stabilizing the shoreline as well as improving MacDill's vast natural habitats. This build is part of the ongoing Oyster Reef Shoreline Stabilization project, which started in 2004. (Department of the Air Force photo by Staff Sgt. Tori Long)

The department released an *Infrastructure Investment Strategy* in 2019 to drive future funding strategies toward investing in an adaptive, resilient, right-sized, and fiscally sustainable infrastructure. The department invests in infrastructure to sustain DoD mission-essential functions, ensure readiness of power projection platforms, modernize infrastructure, innovate installation management practices, and decrease demands to climate-constrained resources, such as energy and water.

Collaboration with surrounding communities and industry is essential. The department will continue to develop solutions and share technologies alongside local communities, industry partners, and allies and partner nations to create holistic solutions for improving installation adaptability and resiliency.



## OBJECTIVES AND KEY RESULTS FOR PRIORITY 1 - MAINTAIN AIR AND SPACE DOMINANCE IN THE FACE OF CLIMATE CHANGE

### Objective 1: Modernize Infrastructure and Facilities

Invest in climate-ready and resilient installations to provide the platform from which to project air and space combat power.

#### Key Results (KR):

- **KR 1.1:** Targeted investments to improve base resilience, starting with \$36 million in fiscal year (FY) 23 and increasing to \$100 million per year by FY27.
- **KR 1.2:** Framework established to evaluate the effects of climate change at all department installations to inform resourcing and basing processes by FY24.
- **KR 1.3:** Department of the Air Force *Severe Weather and Climate Hazard Screening and Risk Assessment Playbook* fully implemented at installations requiring an Installation Development Plan in accordance with Department of the Air Force Instruction 32-1015, by the end of FY26, with identified climate hazards and risks incorporated into planning and project development processes.
- **KR 1.4:** Energy Resilience Readiness Exercises executed at 35 installations by the end of FY27, with results used to inform installation investments and facilitate mission execution from energy-efficient and climate-resilient bases.
- **KR 1.5:** Installation Energy Plans completed for installations requiring an Installation Energy Plan in accordance with Department of the Air Force Instruction 90-1701, by FY23, with identified projects submitted to compete for funding starting in FY24.
- **KR 1.6:** Department of the Air Force's installations portfolio is net-zero emissions by FY46, including a 50 percent emission reduction from 2008 levels by FY33.

## PRIORITY 2 – MAKE CLIMATE-INFORMED DECISIONS

To institute enduring advantages while combating the effects of climate change, we must fundamentally shift the way the department thinks, prepares, and acts. As we execute the department's priorities through our planning documents, in our actions, and across our acquisitions, we must be deliberate in considering climate risks and implications. We will examine how we prepare our personnel, utilize data, and develop strategic plans, requirements, and wargames. Climate considerations must be incorporated throughout our processes, plans, and decisions to develop and field a more agile, resilient, combat-credible force for today and into the future.



Lt. Gen. Kenneth Wilsbach, Alaskan Command commander, and Gen. Ellen Pawlikowski, Air Force Materiel Command commander, look at a cold weather gear display during an Arctic Security Expedition Sept. 8, 2017, at Eielson Air Force Base, Alaska. Air Force senior leaders from Headquarters Air Force and major commands visited Eielson AFB and other locations in Alaska to learn and discuss the challenges units face operating in the Arctic region and the effects climate change may have on their mission. (Department of Air Force photo by Staff Sgt Jerilyn Quintanilla)

Developing a climate-literate workforce ensures that department personnel have the knowledge, skills, and abilities to understand when, why, and how to apply climate considerations to improve the department's ability to field a ready force. Mission requirements remain our highest priority; we seek to inform plans, processes, and decisions with climate change considerations. The department will rely on this climate-literate force to develop innovative solutions for using energy and addressing climate risks, improving our ability to adapt and to reduce greenhouse gas emissions.



A climatology education session for a 14th Weather Squadron course includes discussions of climate projection methodologies. (Department of the Air Force photo by 14th Weather Squadron)

### MAKE CLIMATE-INFORMED DECISIONS

#### GOAL

- Department is equipped with the knowledge, skills, and abilities to mobilize, deploy, and sustain a combat-credible force globally in the face of climate threats.
- An established culture of incorporating climate change considerations across our processes, plans, and decisions to build a more climate resilient force while also reducing future climate risk.



By instilling a culture in which Airmen and Guardians understand the implications of climate change, our personnel will be empowered to make climate-informed decisions to improve the readiness and operational capability of the force.

Accurate climate data and predictive analytics are critical to decisions that impact everything from the development of engineering standards for installations, to the acquisition and life-cycle sustainment of weapon systems, to planning and operations.

The department will continually acquire improved extreme weather sensing solutions, develop expertise, and analyze authoritative climate and extreme weather data to enable an informed understanding of the operating environment. This understanding serves as a strategic advantage over adversaries and assists the department in optimizing our operational performance and our resourcing decisions.

Our strategic efforts align with the National Defense Strategy, the DoD Climate Adaptation Plan, and

the DoD Climate Risk Analysis, which call upon the military services to fully incorporate climate considerations into their plans and policies. Our strategic efforts are also consistent with the 2020 Department of the Air Force Weather Enterprise Strategy, which outlines the department's plan to develop and augment our space-based environmental monitoring capabilities for timely and accurate weather products to make informed decisions for Joint operations, especially over denied and austere areas. We are actively working to incorporate climate change considerations into our internal documents, ranging from futures and foresight analysis to our methodology in developing future war-fighting concepts to our requirements in developing future war-fighting capabilities. The department is seeking ways to better measure energy use in its current weapon systems and creating criteria to emphasize energy optimization in the development of future weapon systems.

Wargaming is one of the department's primary evaluation tools, helping us test new platforms, optimize fuel delivery logistics, and factor in environmental risks that could impact our ability to win in a contested environment. Future wargames will include an increased emphasis on incorporating allies and partner nations, and on testing sustainment capabilities, as both aspects of warfare have proven to be key to successful power projection.

Collaborating with others is foundational to addressing the effects of climate change and to reducing greenhouse gas emissions. Close cooperation with



*The 607th Weather Squadron setting up a tactical meteorological observing system used to support mission operations. (Department of the Air Force photo by American Forces Network Humphreys)*

national security stakeholders (Federal agencies, Congress, state and local entities, private industry, academia, non-governmental organizations, and the American people), as well as allies and partner nations, will help to secure our common interests and promote our shared values. As we undertake departmental transformation, we will also ensure interoperability with our allies and partner nations, a key component to maintain integrated deterrence. Further, we will expand collaborative planning opportunities to exchange knowledge and share innovative technologies and to achieve economies of scale with our stakeholders, other military services, and international partners. Our activities will also reflect the forthcoming, updated DoD Environmental Justice Strategy. Environmental justice considerations require that department programs, policies, and activities address disproportionately high and adverse human health, environmental, climate-related, and other cumulative impacts on disadvantaged communities.

Finally, as we work to incorporate climate considerations into supply chain guidance and strategies to increase supply chain resilience for the delivery of goods and services, we will reduce risk to the industrial base, and better prepare the department to project power globally. Ultimately, climate considerations in requirements development and acquisition have a direct impact on long term mission assurance and effectiveness.



*An Integrated Air and Missile Defense Wargame at Joint Base Pearl Harbor-Hickam, Hawaii. Wargames can improve understanding of potential operational impacts from extreme weather and climate. (Department of the Air Force photo)*

## OBJECTIVES AND KEY RESULTS FOR PRIORITY 2 - MAKE CLIMATE-INFORMED DECISIONS

### Objective 2.1: Develop a Climate-Informed Workforce

Developing a climate-informed workforce ensures that department personnel have the knowledge, skills, and abilities to understand when, why, and how to apply climate considerations to improve the department's ability to field a ready, combat-credible force.

#### Key Results (KR):

- **KR 2.1.1:** Climate considerations integrated into department professional military education curriculum by FY24.
- **KR 2.1.2:** Climate considerations integrated into department technical and continuing education curriculum by FY25.



## Objective 2.2: Integrate Security Implications of Climate Change into Department Strategy, Planning, and Operations

Incorporating the security implications of climate change into our processes, plans, and decisions enables the department to develop a more agile, responsive, and ready force that extends the department's ability to support integrated deterrence and project power globally.

### Key Results (KR):

- **KR 2.2.1:** Climate considerations, security language, and goals incorporated in Air Force and Space Force concept development and Air Force Major Command and Space Force Field Command operational plans and campaign plans starting in FY24.
- **KR 2.2.2:** Climate considerations incorporated into department Title 10 wargames starting in FY23.
- **KR 2.2.3:** Potential effects and security implications of climate change included in engagements with allies and partner nations starting in FY23.

## Objective 2.3: Incorporate Climate Considerations into Department Requirements, Acquisition, and Supply Chain Processes

Incorporating climate considerations into the department's requirements process, materiel acquisition regulatory guidance, and supply chain guidance and strategies enables the department to purchase, field, and continuously supply a more agile, resilient, combat-credible force to support integrated deterrence and power projection globally.

### Key Results (KR):

- **KR 2.3.1:** Energy Key Performance Parameters incorporated in weapon system capability requirements in accordance with the Joint Capabilities Integration and Development System Manual.
- **KR 2.3.2:** Effects of climate change identified for select supply chains by end of FY23 with risk mitigation approaches informed by the end of FY24.

### PRIORITY 3 – OPTIMIZE ENERGY USE AND PURSUE ALTERNATIVE ENERGY SOURCES

Reversing the effects of climate change will require a global response—we cannot do this alone. The actions we undertake today to optimize our energy use and to diversify energy sources will make a difference in increasing the department’s air and space dominance and combat effectiveness.

#### OPTIMIZE ENERGY USE AND PURSUE ALTERNATIVE ENERGY SOURCES

##### GOAL

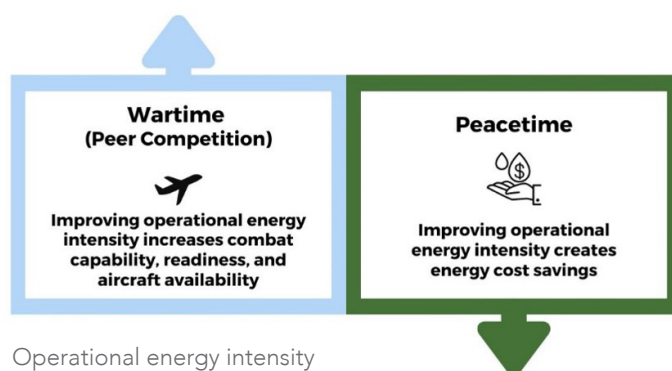
- Reduced demand on the department’s logistics and sustainment tail and improved ability to sustain a combat-credible force in support of integrated deterrence.
- Decreased department contribution to future climate risk via the reduction of greenhouse gas emissions.

Fuel is simultaneously a vital enabler and a limiting factor to our operational capability; fuel is often the primary determining factor in how far we can go and where we can go around the globe. Throughout wargames and real-world scenarios, fuel storage, logistics support, and lines of communication are consistently shown to be a liability that is frequently targeted by our adversaries. As we retool our warfighting and power projection capabilities, we must decrease our fuel demand and diversify how we generate power.

Operational energy (aviation fuel and energy to power aircraft) comprises over 80 percent of the department’s energy use. Reduction of fuel use offers the most significant opportunity to optimize our operational capability while simultaneously

reducing greenhouse gas emissions. To accelerate change and meet 21st century energy demands, we will continue to optimize our processes, technologies, and weapon systems to support joint all-domain operations globally as we combat the growing threat to our logistics capabilities and capacity. Collaborating with joint and international partners, through such forums as the Global Air Forces Climate Change Collaboration and the State Partnership Program, will remain foundational to our success as we share valuable knowledge and innovative technologies and ensure interoperability. In the short term, the pursuit of low-cost, high-return investments will optimize aviation fuel use, increase range and time-on-station, decrease maintenance issues, and streamline planning for our platforms.

Our overall goal is to deliver more combat power to the warfighter using less fuel. For the Air Force, this is measured by operational energy intensity, referred to as “lethality per gallon.” For example, if a mobility aircraft consumes less fuel to deliver the same amount of cargo or fuel to the warfighter, whether it is because of aerodynamic advancements or more streamlined flight planning, then the operational energy intensity improves – providing more lethality per gallon. Each initiative’s individual metric, such as test events per gallon or offload per gallon, is then aggregated into an overall operational energy intensity metric, allowing us to effectively measure percentage improvements over time.





The department is working with industry to incorporate commercially proven drag reduction technologies onto current platforms, modernize aircrew and aircraft planning and allocation software, employ engine sustainment technologies, and increase the use of simulation and augmented reality systems. We will also employ cost-savings rebates to incentivize energy-aware behavior in Airmen. The Mission Execution Excellence Program (MEEP) is a new initiative focused on optimizing fuel usage in mobility aircraft that consume the largest portion of the Air Force's fuel. The program leverages innovative ideas from Airmen, employs commercial aviation best practices, and equips aircrew members with more precise fuel planning tools. This will help instill a culture of efficiency among Airmen, both to prepare for conflict with a near-peer adversary



Capt Gary Olkowski demonstrates how to use Jigsaw, a tanker planner tool, which digitizes and streamlines aerial refueling planning. Jigsaw reduces fuel use by 180K gallons per week and prevents 46K metric tons of CO2 emissions annually. (Department of the Air Force photo)



and reduce total fuel consumption by an estimated 26 million gallons annually.

Over the next five years, we estimate these efforts will cut greenhouse gas emissions by a combined 3.7 percent (or approximately 650,000 metric tons annually), the equivalent of 67 million gallons of fuel. By 2032, we aim to double this reduction in greenhouse gases.



Upper left: The X-48B Blended Wing Body technology demonstrator aircraft, developed by NASA and Boeing (Boeing photo); Upper right: Six Microvanes™ bonded to the aft end of a C-17 Globemaster III fuselage (U.S. Air Force photo); Lower right: The engine of an AC-130J Ghost rider is washed with Aerocore's nucleated foam wash (Aerocore photo); Lower left: U.S. Air Force student pilots train on a virtual reality flight simulator (U.S. Air Force photo).

To meet our ambitious objective, we will need additional investment in fuel-saving projects such as advanced winglets, compressor blade coatings and scanning, and engine wash technology.

The department is also pursuing longer term initiatives that promise revolutionary advances in aircraft propulsion and design, as well as in development and use of alternative fuel sources. Agility Prime, an Air Force-led innovation program, is exploring the electrification of rotorcraft and small mobility aircraft to decrease fuel logistics risk and improve readiness. We are also collaborating with the Defense Innovation Unit, the National Aeronautics and Space Administration, and industry partners to accelerate prototyping of ultra-efficient aircraft designs for future tanker and mobility aircraft. For example, development of blended wing body

aircraft could drive transformative changes, as this aircraft design increases aerodynamic efficiency by at least 30 percent over current Air Force tanker and mobility aircraft and enables dramatically greater fuel offload at range to ensure strike capabilities in a contested environment.

The department is piloting projects that produce fewer greenhouse gas emissions and assessing their viability to support installation energy efficiency enterprise-wide. At Eielson Air Force Base, Alaska, the department is piloting the DoD's first micro-reactor to promote energy security and independence by employing a safe and resilient source of carbon pollution-free energy. Efforts are also underway to electrify non-tactical support vehicles and equipment, including deployment demonstrations to test their integration with existing



*The solar array installed at Hill Air Force Base, Utah, in 2018 increased the amount of renewable energy produced on base and will be incorporated into future microgrid planning. The new system was installed through an Energy Savings Performance Contract that costs the government no upfront money. Energy Solutions Group will operate and maintain the system during the 23-year arrangement. Pictures show a conduit line being installed and electrical wiring clips attached to the new panels. (Department of Air Force photo by R. Nial Bradshaw)*

infrastructure and to inform strategic implementation across the department. These innovative solutions will promote energy resilience and lead technological innovation over competitors.

The department is expanding the use of renewable and alternative energy sources at Air Force and Space Force bases by executing over 300 renewable energy projects. In FY 2021, 6.9 percent of Department of the Air Force electricity came from renewable sources including from a 3.55 megawatt (MW) solar array at Hill Air Force Base, a 15MW solar array at Nellis Air Force Base, a 28MW solar array at Vandenberg Space Force Base, and a 33.5MW solar array at Eglin Air Force Base. We will continue to research opportunities for exploring alternative energy sources for both installations and weapon systems to diversify our energy options while

sending a “demand signal” to industry, which will need to supply those options for our use.

Finally, in order to achieve our fuel efficiency objectives, we must collect, access, and analyze operational energy data to identify additional areas of improvement. Fuel use data is critical to understanding how operational energy impacts department combat capability. With accurate, comprehensive, and accessible data on aviation and launch vehicle fuel use, the department can account for fuel use impacts to mission effectiveness and greenhouse gas emissions, as well as evaluate the impact of operational efficiency optimization actions. Further, tracking and analyzing installation and infrastructure energy use will help capture progress towards modernizing our infrastructure and facilities.



Workers prepare to splice a “T” pipe while installing a geothermal system at Selfridge Air National Guard Base, Michigan, September 29, 2011. (Department of Air Force photo by John Swanson)

## OBJECTIVES AND KEY RESULTS FOR PRIORITY 3 - OPTIMIZE ENERGY USE AND PURSUE ALTERNATIVE ENERGY SOURCES

### Objective 3.1: Improve Operational Energy Intensity

Optimized aircraft energy use increases the readiness and operational capability of the department, decreases risk to logistics supply chains, and informs operational plans while reducing greenhouse gas emissions. Optimization includes the adoption of ultra-fuel-efficient aircraft designs, which provide an opportunity to significantly improve combat capability.

#### Key Result (KR):

- **KR 3.1.1:** Operational energy intensity of Air Force flying missions increased 5 percent by FY27 and 7.5 percent by FY32 through standardized use of aircraft drag reduction technologies, modern software scheduling tools, and enhanced engine sustainment practices.
- **KR 3.1.2:** Development and testing of a full-scale blended wing body prototype completed by FY27.

### Objective 3.2: Adopt Alternative Energy Sources

While the department cannot singularly reverse the causes of climate change, we can reduce our energy footprint and increase demand for zero-carbon-based energy sources. We must both reduce our energy consumption and move toward carbon pollution-free energy sources.

- **KR 3.2.1:** Completed successful pilot of drop-in compatible sustainable aviation fuel at two operational Air Force locations by FY26, where 10 percent of all purchased aviation fuels consist of sustainable aviation fuel blends at the same or less cost than traditional aviation fuel. The pilot project will validate operational, infrastructure, and logistical requirements for blending and quality control in the use of sustainable aviation fuel.
- **KR 3.2.2:** Completed successful pilot of micro-reactors by FY28 to demonstrate viability of this technology as a feasible alternative energy source.
- **KR 3.2.3:** 100 percent carbon pollution-free electricity on a net annual basis by FY30, including 50 percent 24/7 carbon pollution-free electricity.
- **KR 3.2.4:** 100 percent zero-emissions non-tactical vehicle acquisitions by FY35, including 100 percent zero-emission light-duty vehicle and aircraft support equipment acquisitions by FY27 and FY32, respectively.

## CONCLUSION

By maintaining air and space dominance in the face of climate risks, making climate-informed decisions, and optimizing energy use and pursuing alternative energy sources, the department will prove resilient to the effects of climate change and preserve a combat-credible force that can compete, deter, and win.



## GLOSSARY

**24/7 Carbon Pollution-Free Electricity:** Carbon pollution-free electricity procured to match actual electricity consumption on an hourly basis and produced within the same regional grid where the energy is consumed. (Executive Order 14057, Catalyzing Clean Energy Industries and Jobs through Federal Sustainability)

**Adaptation:** Adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative effects. (DoD Directive 4715.21, Climate Change Adaptation and Resilience, August 31, 2018)

**Climate Change:** Variations in average weather conditions that persist over multiple decades or longer that encompass increases and decreases in temperature, shifts in precipitation, and changing risk of certain types of severe weather events. (DoD Joint Publication 1)

**Climate-Literate:** An understanding of future climate conditions and risks to inform strategies, plans, and operations. (Department of Air Force working definition)

**Carbon Pollution-Free Electricity:** Electrical energy produced from resources that generate no carbon emissions, including marine energy, solar, wind, hydrokinetic (including tidal, wave, current, and thermal), geo-thermal, hydroelectric, nuclear, renewably sourced hydrogen, and electrical energy generation from fossil resources to the extent there is active capture and storage of carbon dioxide emissions that meets U.S. Environmental Protection Agency requirements. (Executive Order 14057, Catalyzing Clean Energy Industries and Jobs through Federal Sustainability)

**Non-Tactical Vehicles:** Any commercial motor vehicle, trailer, material handling or engineering equipment that carries passengers or cargo acquired for administrative, direct mission, or operational support of military functions. All DoD sedans, station wagons, carryalls, vans, and buses are considered "non-tactical." (DoD Instruction 4500-36, Acquisition, Management, and Use of Non-Tactical Vehicles (NTVs))

**Operational Energy Intensity:** Measurement of lethality (e.g., the unit output or mission activity) per gallon. Example metrics: actual ton miles per gallon, offload per gallon, test events per gallon, time on station per gallon, simulated/actual weapons released per gallon, collections per gallon, pilots (B-course equivalent) per gallon, and syllabus events per gallon.

**Resilience:** Ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. (DoD Directive 4715.21, Climate Change Adaptation and Resilience, August 31, 2018)

**Right-sized:** A "right-sized" installation portfolio optimizes infrastructure quantity and quality to assure combat readiness and protect our operational capability, enabling multi-domain missions across the full spectrum of operations. (Department of Air Force Basing and Logistics Flight Plan, Civil Engineer Annex, January 2020)





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