

DoD Climate Change Overview

Innovations in Climate Resilience (ICR23)



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POC: Dr. Kate White



Meet the Climate Crisis. Our strategy and planning addresses the security implications of our changing climate. We are developing new platforms that mitigate logistical risks in contested environments. We are also investing to improve mission resilience and cut the risks from extreme weather.

- Lloyd J. Austin III, Secretary of Defense, Message to the Force, March 2, 2023

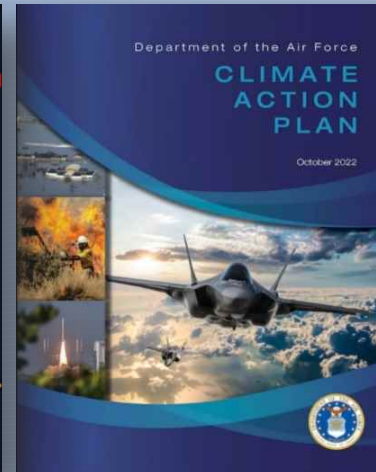
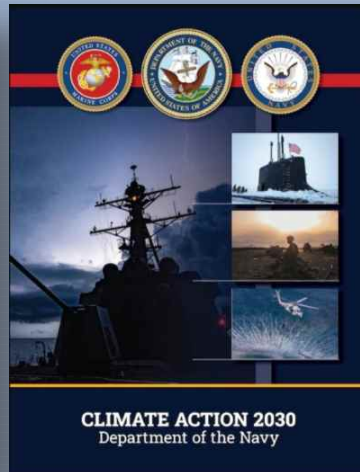
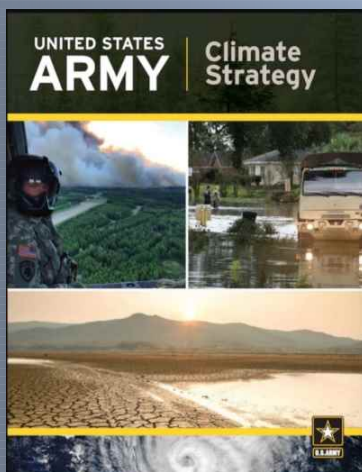
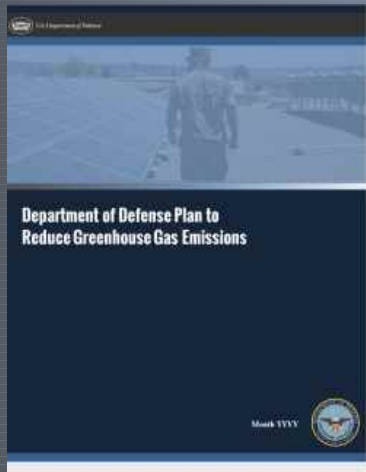
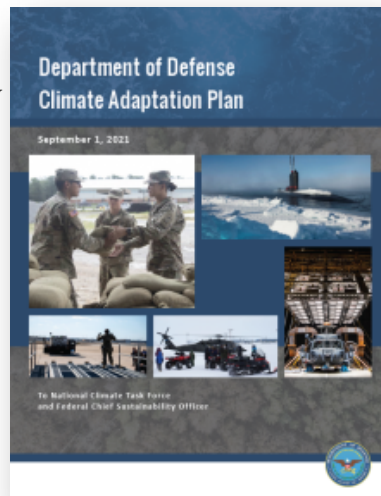




DoD Climate Resilience

DoD Recent and Ongoing Reports

- DoD Climate Adaptation Plan (CAP) signed by Secretary of Defense and publicly released Oct 2021
- DoD CAP Progress Report signed by Secretary of Defense and publicly released Oct 2022
- Sustainability Report publicly released December 2022
- Each Military Department published a climate plan or strategy in 2022; Army released implementation plan
- DoD Plan to Reduce GHG Emissions expected 2023





IBP Reports on Supply Chains - EO 14017

- *Securing Defense-Critical Supply Chains Report*
 - Published in February 2022
 - Provides DoD’s assessment of supply chains in the defense industrial base (DIB)
 - Articulates the Department’s plans to ensure security of supply for items vital to national security
- *Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth*
 - 100-day report, released June 2021
 - Identifies risks in the supply chain for critical technologies such as high-capacity batteries, advanced packaging, and pharmaceuticals



• Focus Areas

- Kinetic capabilities
- **Energy storage and batteries:** high-capacity batteries, with a particular focus on lithium batteries
- Castings and forgings
- Microelectronics
- Strategic and critical materials

Figure 1. DoD's Supply Chain Resilience Framework

BUILDING RESILIENT SUPPLY CHAINS, REVITALIZING AMERICAN MANUFACTURING, AND FOSTERING BROAD-BASED GROWTH

100-Day Reviews under



Securing Defense-Critical Supply Chains

An action plan developed in response to President Biden's Executive Order 14017

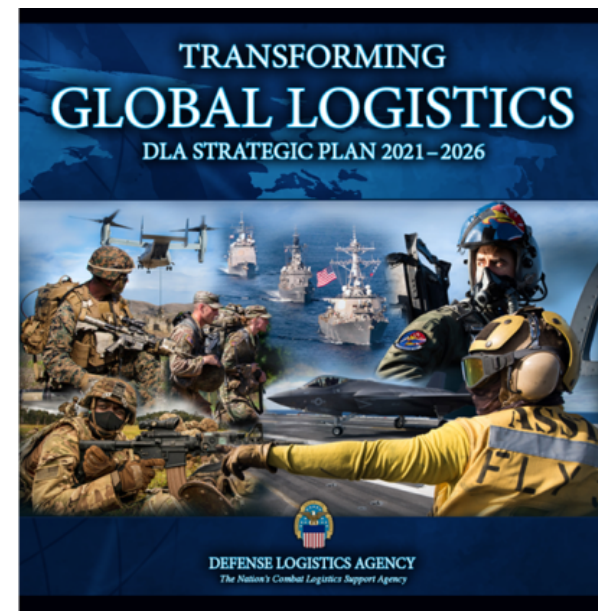
February 2022





Defense Logistics Agency & DoD's Supply Chain

- DLA manages the end-to-end global defense supply chain
- DLA's Environmental and Sustainable Programs:
 - **Disposition Services:** Responsible for demilitarization, reutilization, recycling, and properly managing hazardous waste for the Department.
 - **Precious Metal Recovery Program (PMRP):** Manages DoD Component precious metal (PM) bearing scrap disposal.
 - **Strategic Material Recovery and Reuse Program (SMRRP):** Responsible for operation, oversight, acquisition, retention, and conversion/upgrade of the National Defense Stockpile, recycling of strategic materials from end-of-life Government items, and disposal of excess stocks
 - **DoD Electronics Stewardship Program:** Manages end-of-life processes for equipment from DoD and Federal Civilian Agencies



DLA's 2021 – 2026 Strategic Plan: 5 Lines of Effort





Operational Energy Strategy Framework

	LINES OF EFFORT	ENABLERS	STRATEGIC OUTCOMES	END STATE
1	LOE #1: Energy Demand Reduction <ul style="list-style-type: none"> Improve energy use in existing platforms and operations Adapt policies and procedures to enhance energy demand/supportability in capability development 	RESEARCH AND DEVELOPMENT ALLIES AND PARTNERS	DoD forces enabled by increased range, endurance, and operational flexibility	Joint forces have the energy needed to fight and win in contested operating environments
2	LOE #2: Energy Substitution and Diversification <ul style="list-style-type: none"> Develop hybridized and electrified forces Align with commercially approved Sustainable Aviation Fuel pathways Explore distributed production of alternative energy sources 		DoD gains operational advantages through the use of new energy sources	
3	LOE #3: Supply Chain Resilience <ul style="list-style-type: none"> Assess all-hazard risk of new energy supply chains and adapt policies and procedures to reduce supply chain risks Enhance supply chain resilience and survivability through improved analytics 		DoD forces have access to secure, available, and capable energy supplies and infrastructure	
4	LOE #4: Enterprise-wide Energy Visibility <ul style="list-style-type: none"> Enhance enterprise-wide visibility of energy supply and demand Enable predictive decision-making for mission posture, war-gaming, and defensive and offensive analyses 		DoD forces enabled by responsive energy command and control	



Considering Climate in DOD Decisions Across Time

"The Department will include the security implications of climate change in all our risk analyses, strategy development, and planning. These are essential steps to defend the nation under all conditions."
Lloyd J. Austin III, Secretary of Defense

Amphibious Assault N+3 Days



Decision Maker

Environmental Risk Questions:

- Will predicted fog affect air support or Op timing?
- Will heavy rains flood our staging base?
- With a tropical cyclone nearby, what is expected sea state for landing?

DOD Information Providers



USAF and USN / USMC METOC

- **Tools:** Sensing, satellite, 1-10 day weather forecast models
- **Output:** Weather + Sea State decision aids and machine-to-machine data tied to ops
- **Confidence:** HIGH
- **Science Gaps:** FEW-SOME
- Less climate, mostly weather

Exercise Planning N+120 Days



Decision Maker

Environmental Risk Questions:

- What is the frequency of mission-limiting weather at all exercise locations?
- How much does it snow?
- Will we need to bring cold/warm weather gear?
- Will El Nino affect missions?

DOD Information Providers



USAF & USN Climate Services

- **Tools:** Historical climatology, climate monitoring, analysis, seasonal prediction
- **Output:** Statistical analyses & predictions, narrative reports
- **Confidence:** MEDIUM
- **Science Gaps:** SOME
- Short-term climate

PPBE\$ Budget Process N+1-4YR



Decision Maker

Environmental Risk Questions:

- What extreme weather should I plan for in 4 years?
- Do I have enough budgeted to fight wildfire next year?
- Will my installation see a higher risk of hurricanes?
- Will heat reduce training?

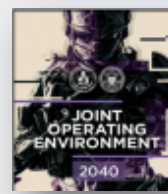
DOD Information Providers



USAF & USN Climate Services, and OSD A&S

- **Tools:** Historical climatology, interannual trends, DCAT
- **Output:** Statistical analyses & predictions, narrative reports
- **Confidence:** LOW-MED
- **Science Gaps:** SIGNIFICANT
- Interannual/decadal climate

Futures Wargame N+10-20YR



Decision Maker

Environmental Risk Questions:

- Where might drought affect food-water-energy security?
- How soon could the Arctic become ice free?
- Will rising sea levels drive coastal migration? When?
- Nations at most climate risk?

DOD Information Providers



USAF Climate Services and OSD A&S

- **Tools:** DCAT, DRSL, historical climate trend some variables
- **Output:** Site climate ranking, future climate/SLR narratives
- **Confidence:** LOW-MED
- **Science Gaps:** LARGE
- Climate projection scenarios

Infrastructure Retrofit N+60YR



Decision Maker

Environmental Risk Questions:

- Will river flooding increase for my installation by 2085?
- What energy loads should I design future buildings?
- Should we consider adaptive relocation for some climate-vulnerable installations?

DOD Information Providers



OSD A&S

- **Tools:** DCAT, DRSL, historical climate trend some variables
- **Output:** Site climate ranking, future climate/SLR narratives
- **Confidence:** LOW-MED
- **Science Gaps:** LARGE
- Climate projection scenarios

Operations and planning vignettes with sample environmental risk questions across the DOD decision time continuum



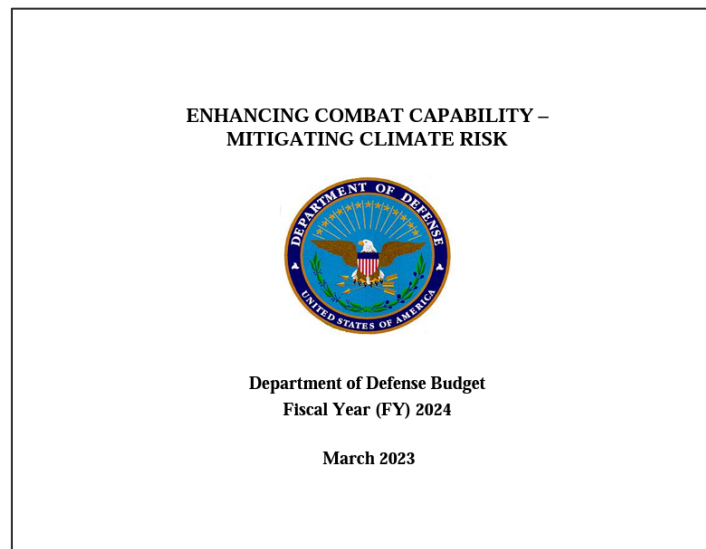
FY24 President's Budget



Enhancing Combat Capability – Mitigating Climate Risk, March 2023

- Installation resilience and adaptation
- Operational energy
- RTD&E
- Contingency Preparedness

<https://comptroller.defense.gov/Budget-Materials/>





Adaptation: Manage Unavoidable Climate Impacts

...by adapting, changing mission, and/or relocating to:

Reduce **Exposure** To

Missions and people

Facilities and supply chains

Internal/External critical infrastructure

Drive Down **Sensitivity** to Sustain

Mission Assurance

Infrastructure integrity

Reliable performance of mission functions

Coming FY24-25

Improve **Adaptive Capacity** By

Prioritizing actions and resources

Institutionalizing capacity building

Improving all-hazards resilience

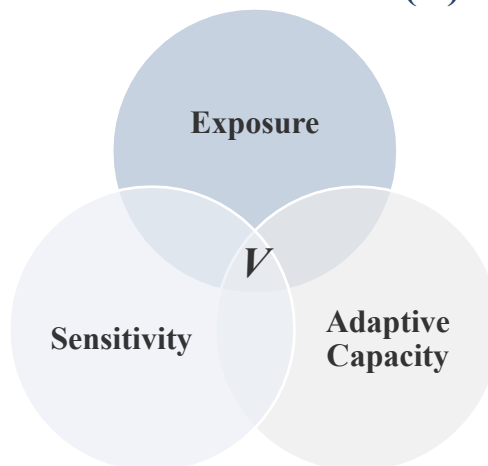
Coming FY24-25

Is there a problem?

Does it matter?

Do we have resources to adapt?

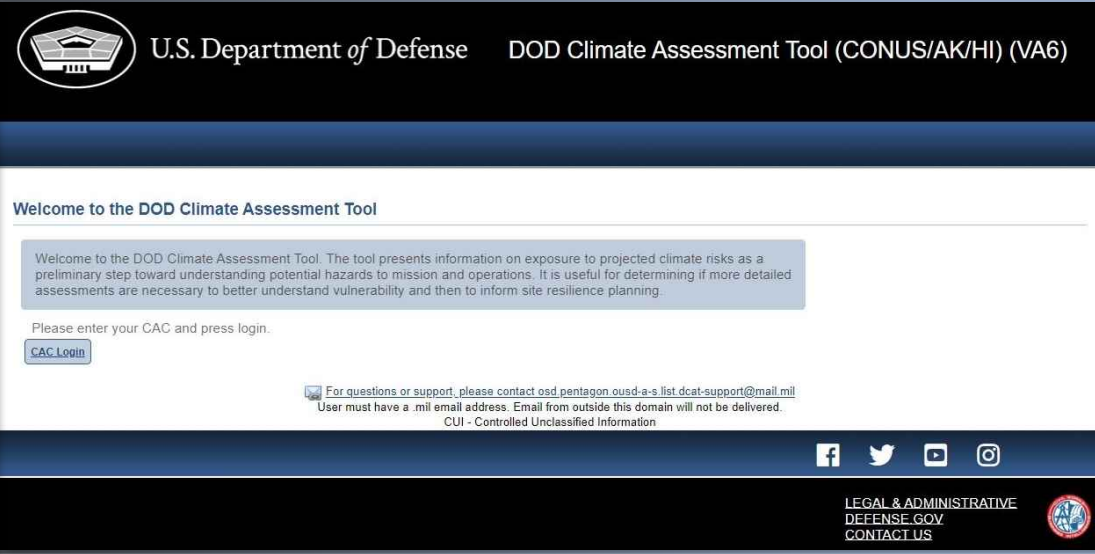
VULNERABILITY (V):





DoD Climate Assessment Tool

- 2023 Expand DCAT to Partner Nations and all major international installations
- 2022 DCAT includes all CONUS major installations
- 2021 DCAT and report released
- 2020 FY20 NDAA mandates DoD Screening Level Vulnerability Assessment Tool
- 2018 Congress requires consistent method across the Dept
- 2016 FY16 NDAA: DoD Screening Level Vulnerability Assessment
- 2014 DoD Climate Change Adaptation Roadmap
- 2011 USACE Climate Assessment Tool



U.S. Department of Defense DOD Climate Assessment Tool (CONUS/AK/HI) (VA6)

Welcome to the DOD Climate Assessment Tool

Welcome to the DOD Climate Assessment Tool. The tool presents information on exposure to projected climate risks as a preliminary step toward understanding potential hazards to mission and operations. It is useful for determining if more detailed assessments are necessary to better understand vulnerability and then to inform site resilience planning.

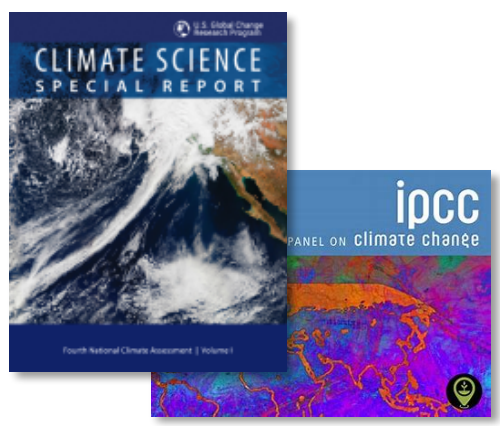
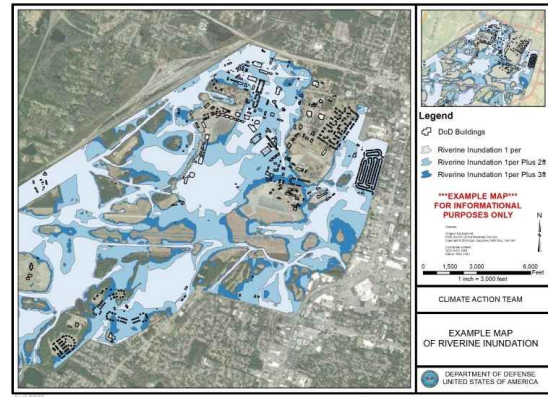
Please enter your CAC and press login.

[CAC Login](#)

For questions or support, please contact osd.pentagon.ousd-a-s.list.dcat-support@mail.mil. User must have a .mil email address. Email from outside this domain will not be delivered. CUI - Controlled Unclassified Information

LEGAL & ADMINISTRATIVE DEFENSE.GOV CONTACT.US

Screening-level assessment of exposure to climate and extreme weather events...



...based on the best available, authoritative, and actionable science.

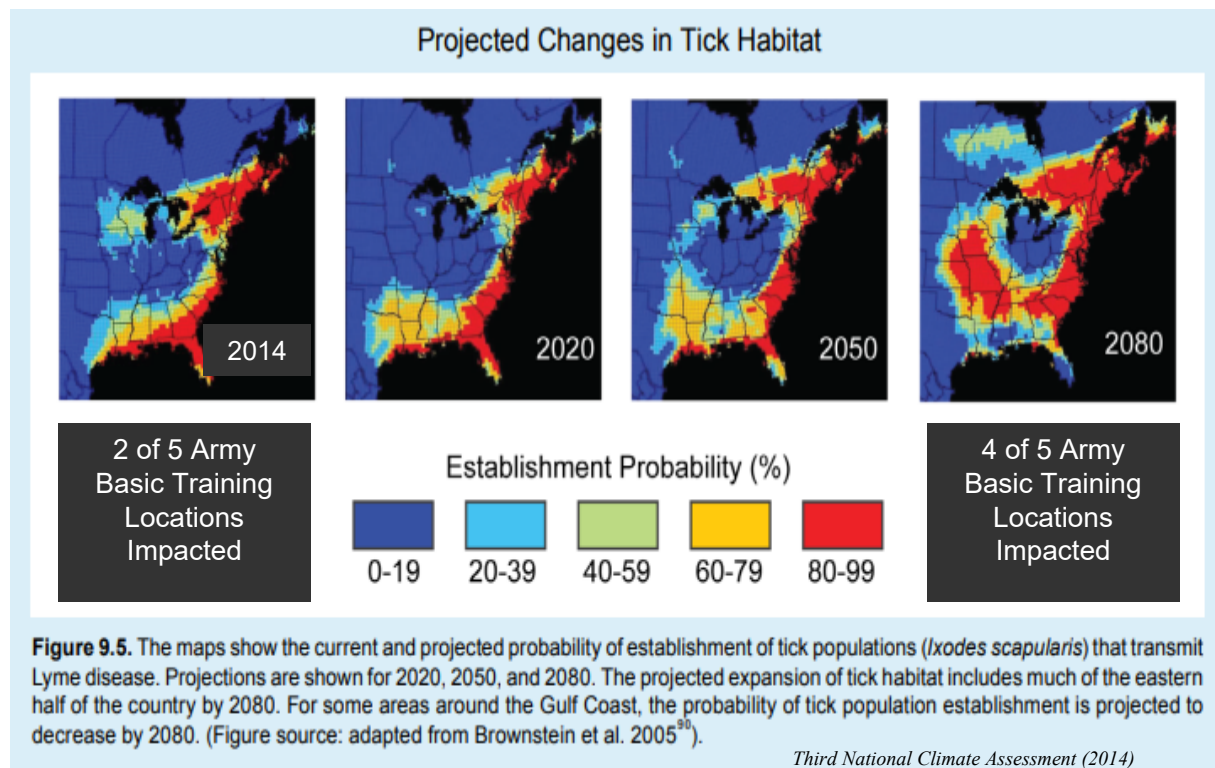
Users include...





Higher Temperatures and Vector-borne Disease Prevalence

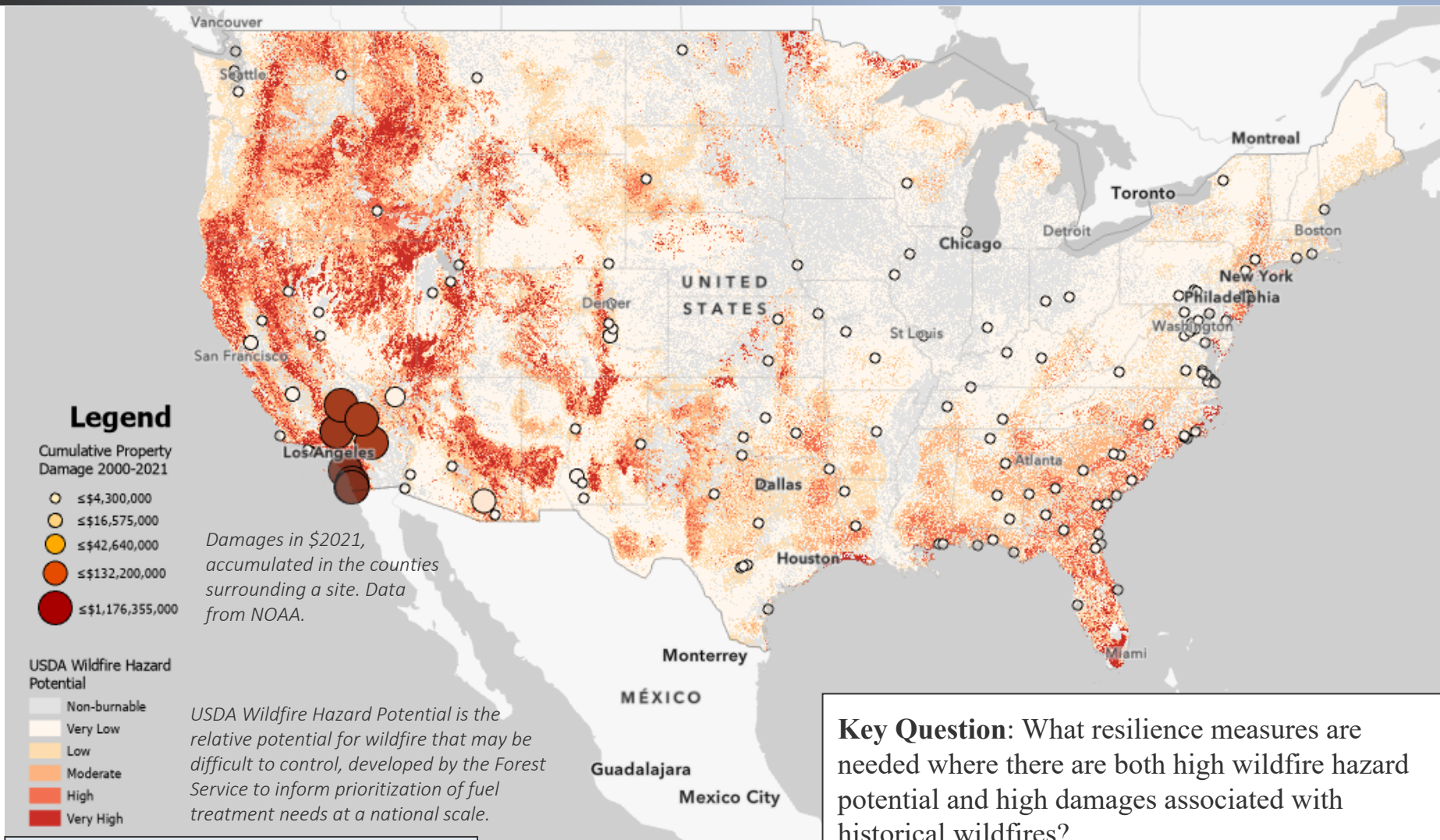
- Exposure to vector-borne diseases rises as temperatures warm, impacting personnel both on-base and off-base.
- Novel pathogens and newly-arriving pathogens complicate the response.



Key Question: What public health measures are necessary given reasonably foreseeable changes to public health and disease vectors?



Wildfire Hazard Potential and Cost – Major Sites in DCAT



Key Question: What resilience measures are needed where there are both high wildfire hazard potential and high damages associated with historical wildfires?

*This analysis is done using different data sources for storm count and damage cost, which assess different time periods.



Climate Mitigation

DoD Plan to Reduce Greenhouse Gas Emissions

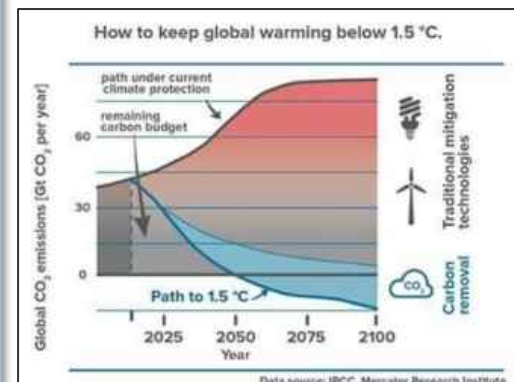
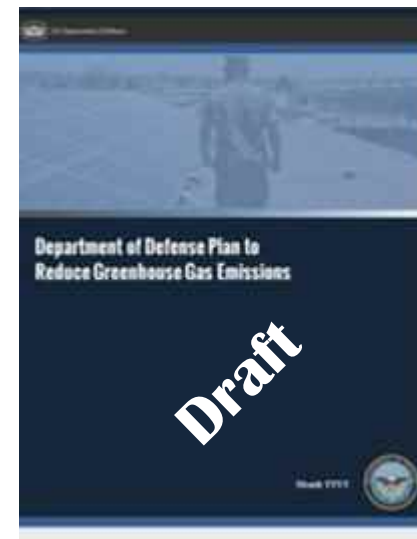
- Signature to be USD(A&S) Dr. LaPlante
- To be followed by Climate Change Report and Adaptation Roadmap, Greenhouse Gas Emissions Briefings to Congress
- FY2022 JES Requirement

Source Reduction

- Monitoring, measuring, modeling, verifying, and quantifying Scope 1, 2, and 3 emissions
- CFEs and carbon offsets

Biosequestration

- Forming DoD Carbon Capture Utilization and Storage (CCUS) working group
- Will manage emerging pressure for CCUS on DoD lands





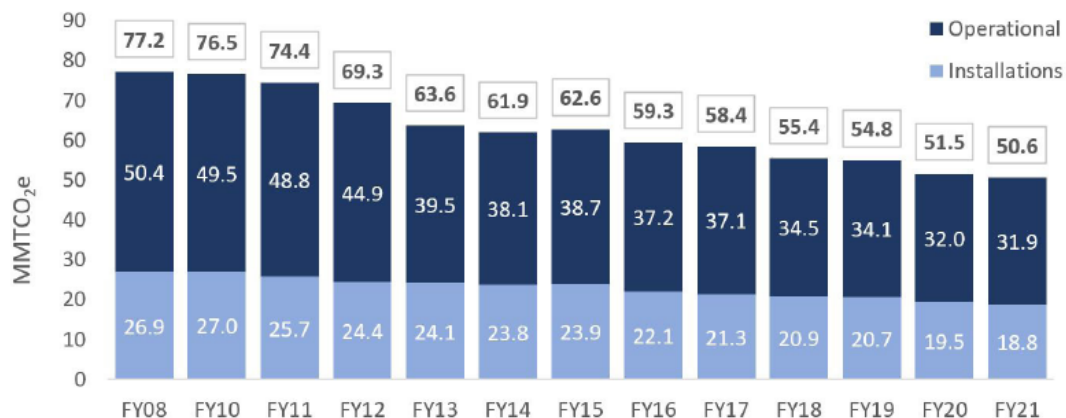
DoD GHG Overview

GHG EMISSION SOURCES BY SCOPE

Scope 1 – Direct emissions from sources that are owned or controlled by DoD, including fossil fuel combustion from stationary and mobile sources and fugitive emissions (such as refrigerant leaks).

Scope 2 – Emissions resulting from the generation of electricity, heat, or steam purchased by DoD.

Scope 3 – Emissions that result from DoD activities but are from sources not owned or directly controlled by DoD, such as DoD procurement of goods and services, including business travel, in addition to emissions from commuting.



Note: DoD's emissions have trended downward since tracking and reporting began in 2010.

Scope 1 and 2 Emissions from FY 2010-2021, along with 2008 baseline.

- The most recent analysis of DoD's GHG emissions in FY 2021 showed that DoD Scope 1 and Scope 2 emissions totaled 51 million metric tons of carbon dioxide equivalent (MMTCO₂e).
- DoD's total 2021 Scope 1 and Scope 2 GHG emissions are about 76% of total Federal Government emissions, equivalent to 1% of the total United States emissions in 2020.



GHG Emissions Reduction: Buildings

Build Less, Lighter, and Smarter

Use Better and Cleaner Materials

Renovate to Decrease Energy and Water Use





GHG Emissions Reduction Plan: Installation Energy

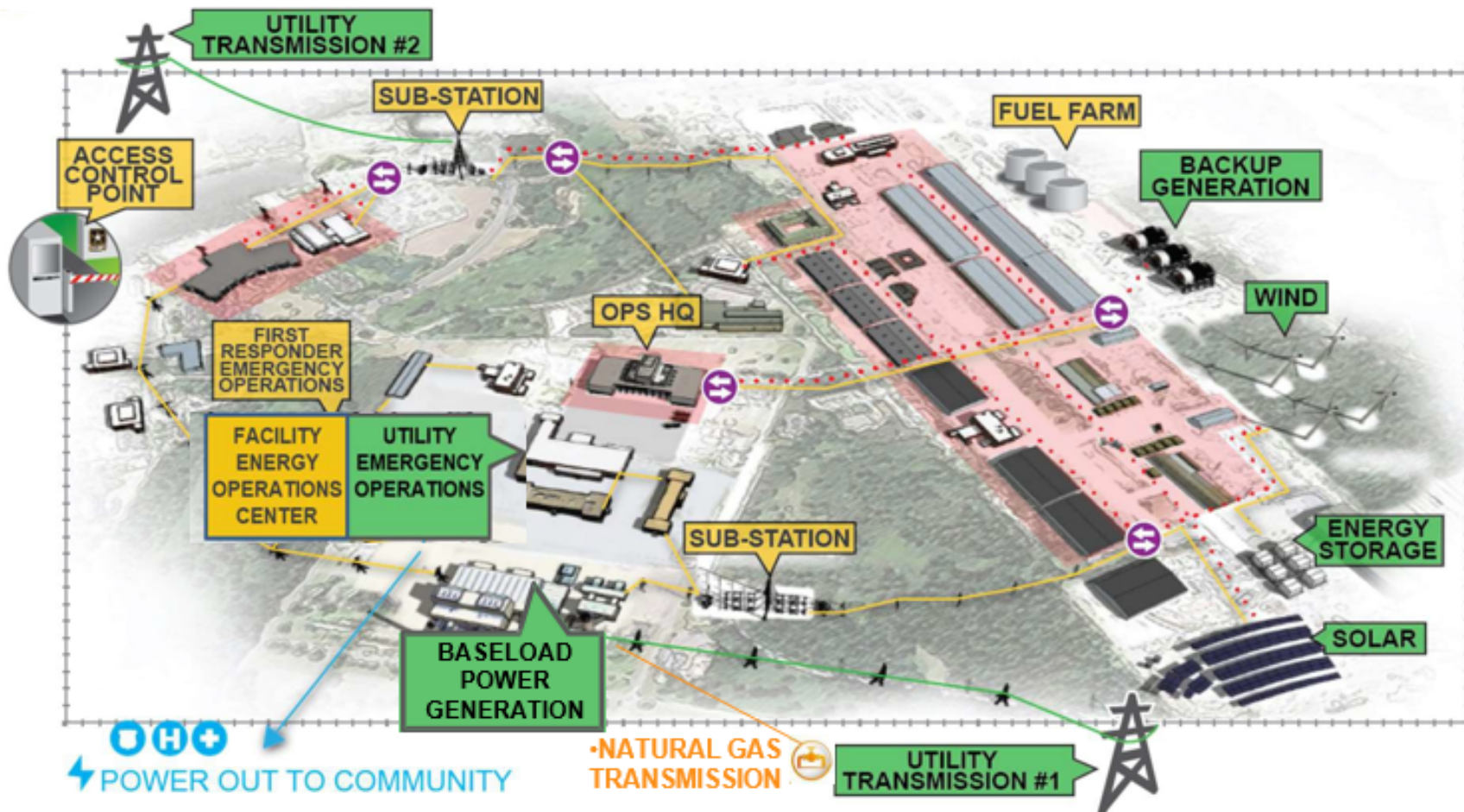
Technological solutions exist to make installations net-zero

Approach: Demand Reduction, Increased Efficiency, Fuel Substitution, Carbon Sequestration

- **Demand Reduction:** Monitoring, measuring, modeling, quantifying Scope 1, 2, and 3 emissions, reduce fugitive emissions, improving data availability, reducing gross facility footprint (square footage), and introducing efficiency upgrades.
- **Increased efficiency:** Accelerate new technologies and processes to improve efficiency and directly reduce GHG emissions.
- **Fuel substitution:** carbon-free electricity, electrification of the non-tactical vehicle fleet, increased renewables.
- **Carbon Sequestration:** Via Natural Resources Management where appropriate, permanently store carbon in natural and built infrastructure.
- **Additionally,** reduce high Global Warming Potential (GWP) materials and eliminate fugitive emissions.



Conceptual Microgrid Example



INSTALLATION ASSET

UTILITY ASSET

Electrical Grid

Secure Installation Microgrid

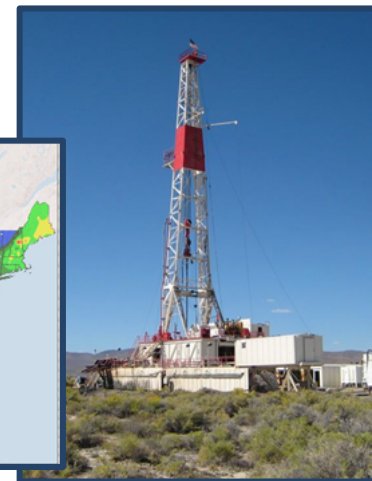
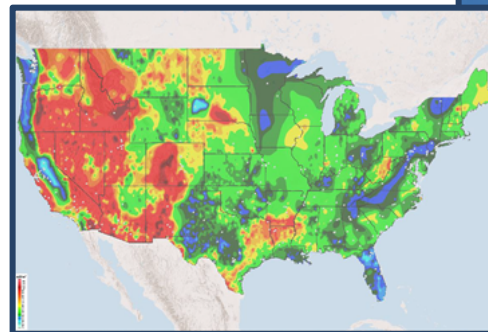
Critical Missions

Electrical Switch



High-Interest: Advanced Geothermal Power

- Next generation geothermal expands access to clean, secure, baseload power
- Advanced, adjacent technologies include non-extractive engineered/closed loop systems, directional drilling, and millimeter wave directed energy drilling
- DoD issued an industry-wide Request for Information (2022), and a solicitation for utility scale prototypes (Jan 2023, results pending)
- Promising prototype locations include, but are not limited to:
 - Joint Base San Antonio, TX
 - Mountain Home Air Force Base, ID
 - Fort Wainwright, AK
 - Fort Irwin, CA





SERDP and ESTCP

- Supporting nearly \$130M in R&D on projects developing technologies for PFAS detection and remediation to address DoD's estimated \$2B liability and development and demonstration of PFAS-free firefighting foams.
- Continuing investments in technologies to address DoD's ~\$20B/year corrosion problem.
- >\$10M investment in FY23 addressing installation built and natural infrastructure resilience.
- Investments in technologies to detect, localize, and classify unexploded ordnance underwater.



**Strategic Environmental Research
and Development Program**

Science and Technology

- Fundamental research to impact DoD environmental land management
- Advanced technology development to address near-term needs



**Environmental Security Technology
Certification Program**

Demonstration/Validation

- Innovative cost-effective environmental and energy technology demonstrations
- Promote technology implementation by direct insertion and partnering with end users and regulators



Operational Energy – Innovation (OE-I)

MISSION/PURPOSE: OECIF and OEPF apply cutting edge science and technology to developing and demonstrating innovative, cost-effective, supportable operational energy solutions to meet joint requirements, lower carbon emissions, and maintain freedom of action in energy constrained environments.

- Supporting over \$238M on 100+ projects developing technologies and capabilities to address contested logistics, efficiencies, electrification, and operations in austere environments
- Investments in technologies to address the administrations focus on Burn Pit and waste disposal and Congressional directives
- Continued investments in studies and technologies providing multi-domain wireless power availability
- >\$5M investment in operational energy studies, standardization, and professional military education programs to shape the future and near future operational energy innovation community



Operational Energy Capability Improvement Fund (OECIF)

- Highly successful program with over 80% successful transition rate out of S&T for 90+ projects
- Advanced technology demonstrations focused on powering the force, electrifying the battlespace, and commanding energy
- Established in 2012 and highlighted in FY2021 NDAA




Operational Energy Prototype Fund (OEPF)

- Established in FY2021 NDAA Sec. 324 (c) for demonstration of technologies related to operational energy prototyping
- Identify and demonstrate the most promising, innovative, and cost-effective technologies and methods that address high-priority operational energy requirements
- Will result in 2+ year acceleration of warfighter capability – increases velocity ahead of Service transition to programs of record



Innovation - New Aspirations & Investment

- USD(R&E) Technology Vision for an Era of Competition
- Three strategic pillars:
 - Mission focus
 - Foundation building
 - Succeeding through teamwork
- Advanced Materials - explore innovative new materials and novel manufacturing techniques
- Microelectronics - circuits and components that serve as the "brain" to human-made electronic functional systems
- Renewable energy generation and storage - solar wind, bio-based and geothermal technologies, advanced energy storage, electronic engines, and power grid integration



UNDER SECRETARY OF DEFENSE
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RESEARCH AND ENGINEERING

February 1, 2022

SUBJECT: USD(R&E) Technology Vision for an Era of Competition

The Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) will spearhead a National Defense Science and Technology Strategy for the Department of Defense (DoD), informed by the 2022 National Defense Strategy (NDS) and structured around three strategic pillars: mission focus, foundation building, and succeeding through teamwork. This technology strategy will chart a course for the United States' military to strengthen its technological superiority amidst a global race for technological advantage.

To maintain the United States military's technological advantage, the Department will champion research, science, technology, engineering, and innovation. From the earliest days of this country the role of technology in shaping military concepts and providing for the defense of the nation has been essential. The demands of the present era call for new operational concepts, increasingly joint operations, and quickly fielding emerging science and technology opportunities.

Strategic competitors to the United States have greater access to commercial state-of-the-art technologies than ever before and can wield these technologies to be disruptive to America's interests and its national security. The challenges facing our country are both diverse and complex, ranging from sophisticated cyber-attacks to supply chain risks, and from defending against hypersonic missiles to responding to biological threats. In an ever shifting and fast-moving global environment, technological advantage is not stagnant and the Department cannot rely on today's technology to ensure military technological dominance tomorrow.

It is imperative for the Department to nurture early research and discover new scientific breakthroughs to prevent technological surprise. The Department must harness the incredible innovation ecosystem both domestically and globally in order to stay ahead of our competitors.

A. Innovation in an era of competition

The Department of Defense's Research and Engineering community welcomes cooperation and competition. As Secretary of Defense Austin said in his December 2021 speech at the Reagan National Defense Forum, "America isn't a country that fears competition. And we're going to meet this one with confidence and resolve." Competition has helped to bring about the United States' private sector and technology industry, both of which are the most vibrant in the world. Competition helped advance the space program, the seeds of modern information technology, and a myriad of derivative technologies that every day drive our national security and economic activity.

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Questions

- **Q&A**
- For more information on DoD, please attend:
Building Climate Resilience: DoD Climate Adaptation and Mitigation Strategies
Presenter: Abby Rice, ODASD(E&ER)
Session: A4
Wednesday, March 29
10:15AM