Battelle Conference on Innovations in Climate Resilience

The Role of Innovation in DoD's Approach to Climate Change Mitigation

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29 March 2022

There is little the Department does to defend the American People that is not affected by Climate Change.

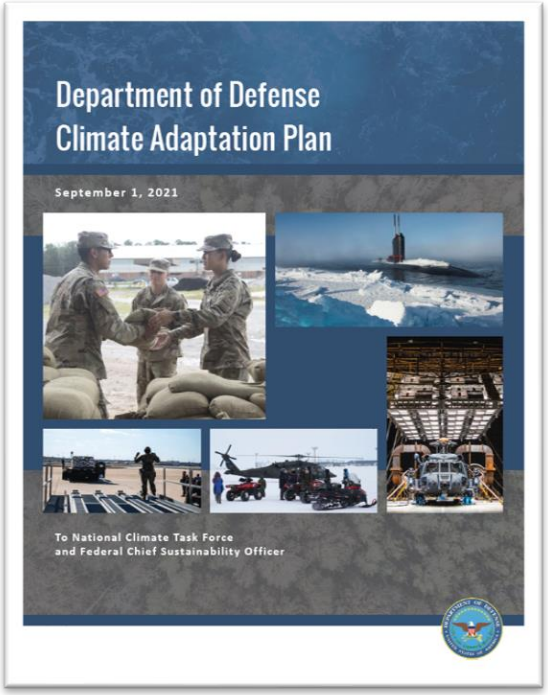
-Lloyd J. Austin III, Secretary of Defense

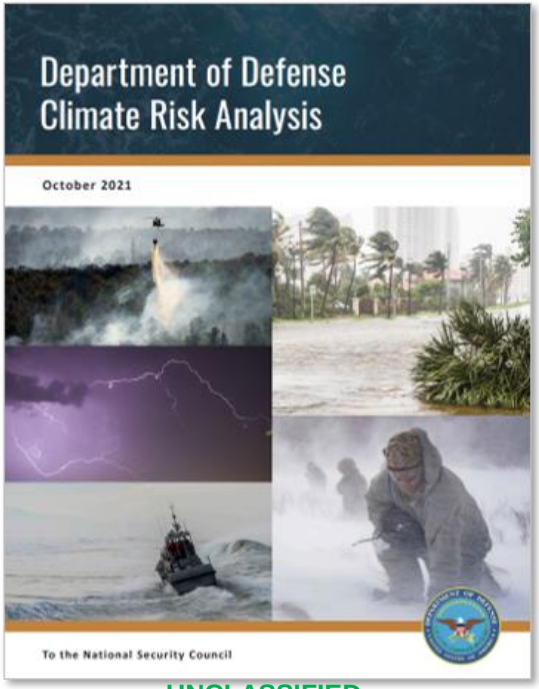
Climate Change is THE context for all future National Security Planning.

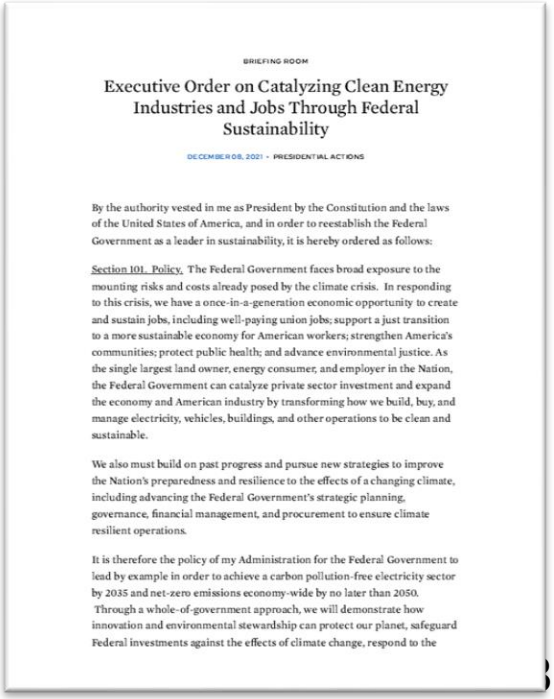
-Deputy Secretary of Defense Kathleen H. Hicks

Climate Change Challenge

- **DOD is experiencing the effects of climate change today.**
- **We are facing a range of requirements to both adapt to and mitigate these challenges.**
- **DOD cannot meet these challenges without significant technological and scientific innovation**







BRIEFING ROOM

Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability

DECEMBER 08, 2021 • PRESIDENTIAL ACTIONS

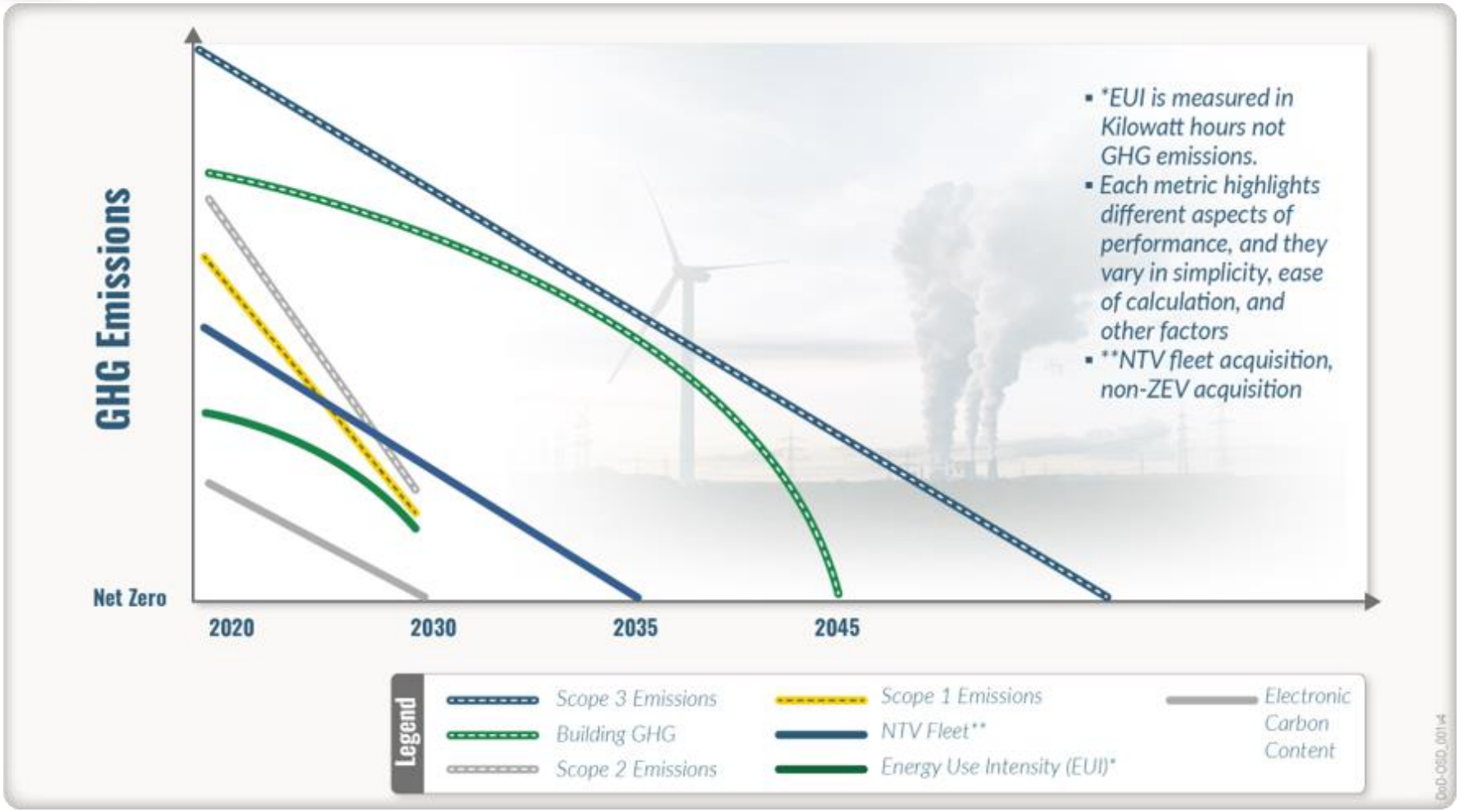
By the authority vested in me as President by the Constitution and the laws of the United States of America, and in order to reestablish the Federal Government as a leader in sustainability, it is hereby ordered as follows:

Section 101. Policy. The Federal Government faces broad exposure to the mounting risks and costs already posed by the climate crisis. In responding to this crisis, we have a once-in-a-generation economic opportunity to create and sustain jobs, including well-paying union jobs; support a just transition to a more sustainable economy for American workers; strengthen America's communities; protect public health; and advance environmental justice. As the single largest land owner, energy consumer, and employer in the Nation, the Federal Government can catalyze private sector investment and expand the economy and American industry by transforming how we build, buy, and manage electricity, vehicles, buildings, and other operations to be clean and sustainable.

We also must build on past progress and pursue new strategies to improve the Nation's preparedness and resilience to the effects of a changing climate, including advancing the Federal Government's strategic planning, governance, financial management, and procurement to ensure climate resilient operations.

It is therefore the policy of my Administration for the Federal Government to lead by example in order to achieve a carbon pollution-free electricity sector by 2035 and net-zero emissions economy-wide by no later than 2050. Through a whole-of-government approach, we will demonstrate how innovation and environmental stewardship can protect our planet, safeguard Federal investments against the effects of climate change, respond to the

Sustainability and Climate Change Mitigation



Driving DoD GHG emissions toward net zero goals.

Thought Experiment:

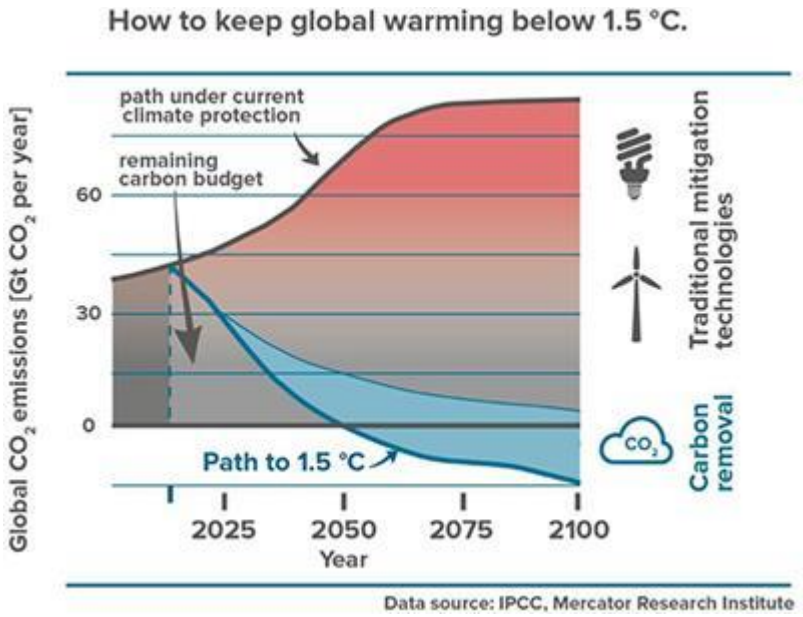
Where is the last gallon of fossil fuel burned?

- An F-35
- A growing country
- Emergency Genset
- An M-1
- ?

Pathways to "Net Zero" DOD:

DOD cannot get to "Net Zero" on current suite of technologies; innovation is needed:

- **Operational Energy Efficiency & Alternatives**
- **Sustainable Liquid Fuels**
- **Installation Energy Efficiency & Resilience**
- **Zero/Negative CO2 construction techniques**
- **CO2 removal through land use improvements**
- **CO2 removal through technology**



IPCC 2018 Figure 2.5

U.S. DNI: National Intelligence Estimate on Climate Change

Climate Change and International Responses Increasing Risks to US Interests Through 2040

Risks to US national security interests through 2040 will increase as countries respond to the intensifying physical effects of climate change. Global temperatures most likely will surpass the Paris Agreement goal of 1.5°C by around 2030, and the physical effects are projected to continue intensifying.

None Low Medium High

Risk		2021	2030	2040
Geopolitical Tensions Over Climate Responses	Perception of Insufficient Contributions to Reduce Emissions	Low	Medium	High
	Carbon Dioxide Removal not at Scale for Countries' Net-Zero Pledges	None	Low	Medium
	Developing Country Demands for Financing and Technology Assistance	Medium	High	High
	Petro States Resisting Clean Energy Transition Away From Fossil Fuels	Low	Medium	High
	Competition With China Over Key Minerals and Clean Energy Technologies	Low	Medium	High
	Contention Over Use of Economic Tools To Advance Climate Interests	None	Low	Medium
Climate Exacerbated Geopolitical Flashpoints	Miscalculation Over Strategic Competition in the Arctic Leading to Conflict	None	Low	Medium
	Cross-Border Water Tension and Conflict	Low	Medium	High
	Cross-Border Migration Attributed to Climate Impacts	Medium	High	High
	Ungoverned Unilateral Geoengineering	None	Low	Medium
Climate Effects Impacting Country-Level Instability	Strain on Energy and Food Systems	Low	Medium	High
	Negative Health Consequences	Low	Medium	Medium
	Internal Insecurity and Conflict	Low	Low	Medium
	Greater Demand for Aid and Humanitarian Relief	Medium	High	High
	Strain on Military Readiness	None	Low	Medium

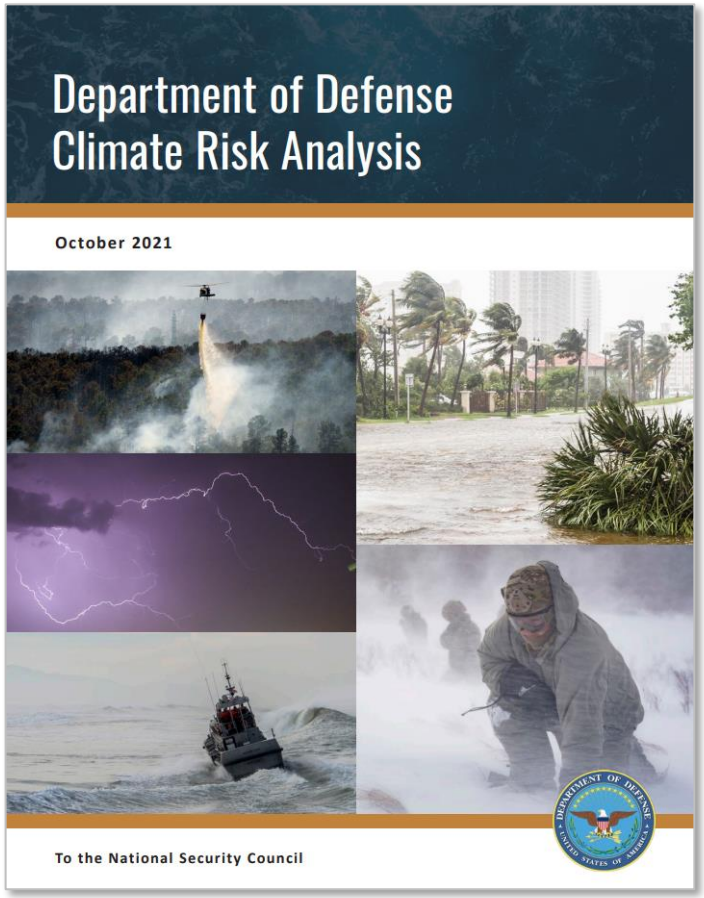
Note: This graphic does not project government and non-government actions that might mitigate risks. The IC defines the level of risk as the probability of the issue occuring multiplied by its assessed impact to US interests.

Source: DNI NIE, Oct 2021

Defense Climate Risk Analysis (DCRA)

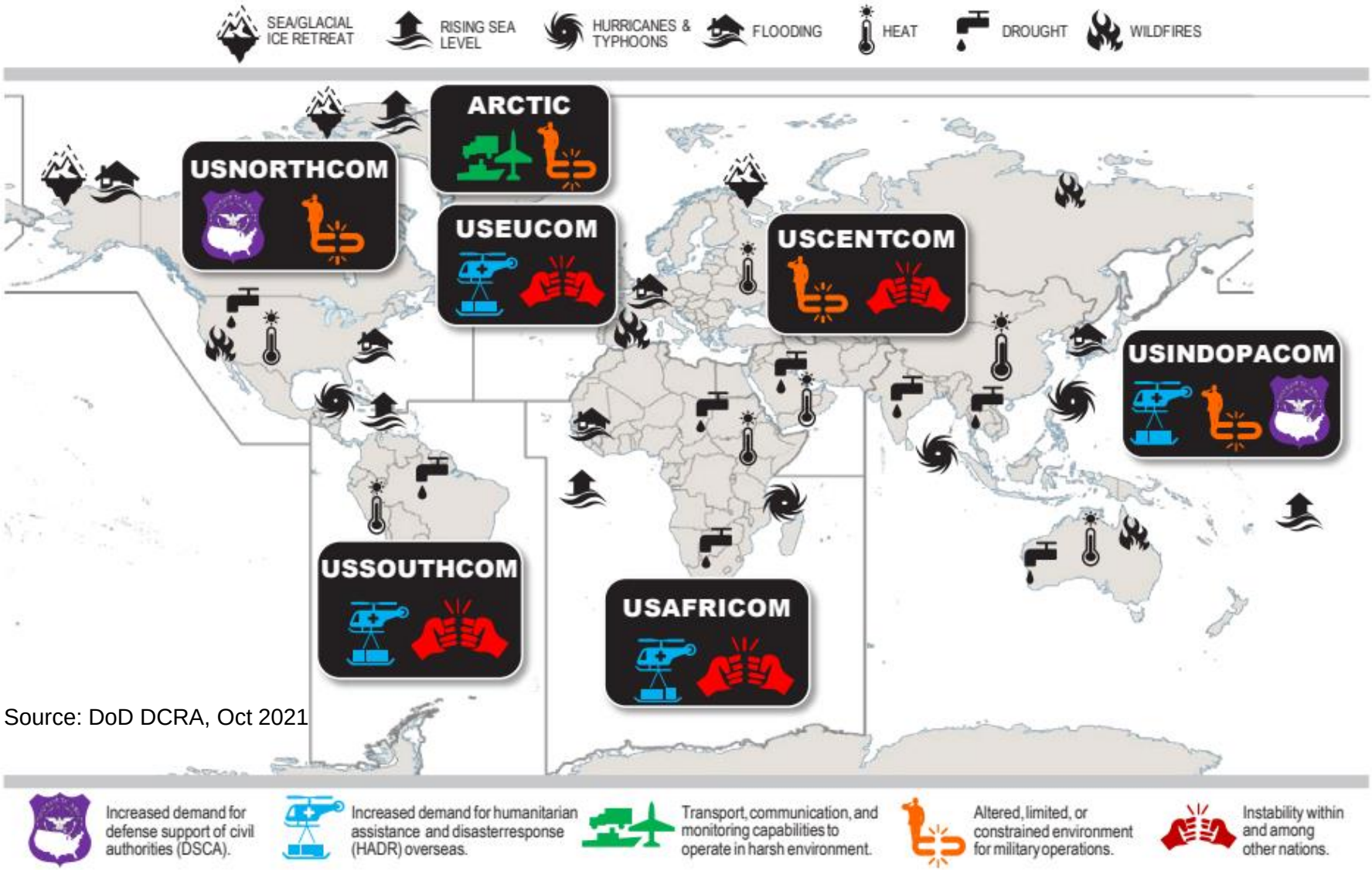
Incorporating climate change security implications across relevant DOD strategy, planning and programming documents and processes.

- **Developed by USD(Policy) per EO 14008, Section 103, issued 27 January 2021**
- **Signed by SECDEF 9 October 2021**
- **UNCLASS version released by White House 21 October 2021**
- **Topline Messages:**
  - The DoD will play a key role in many security scenarios which will be influenced by climate change.
  - Climate poses direct and compounding risks across a variety of sectors and regions.
  - Climate will be incorporated into relevant strategy, planning, and processes through DoD.
- https://media.defense.gov/2021/Oct/21/2002877353/-1/-1/0/DOD-CLIMATE-RISK-ANALYSIS-FINAL.PDF



https://media.defense.gov/2021/Oct/21/2002877353/-1/-1/0/DOD-CLIMATE-RISK-ANALYSIS-FINAL.PDF

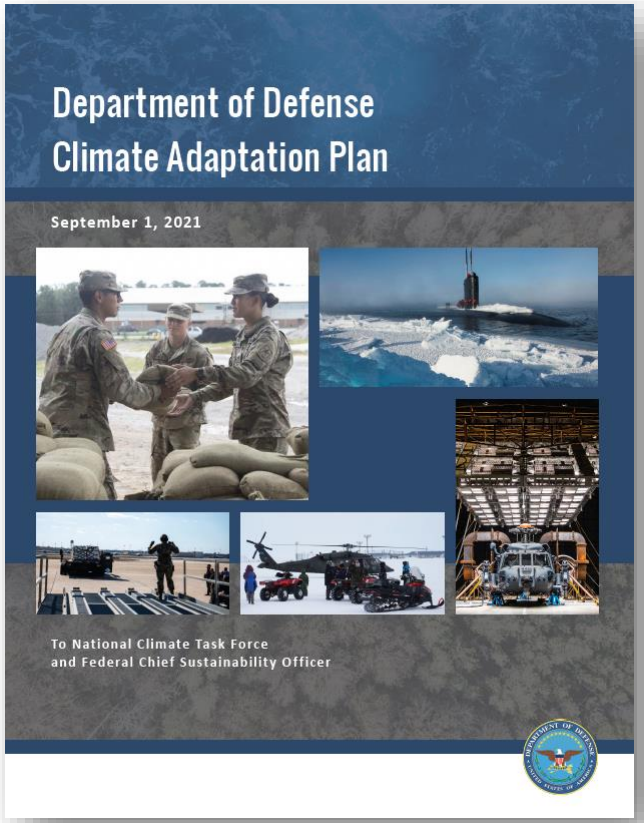
DCRA: Representative Climate Change Hazards/Potential Impacts on DoD Missions



Source: DoD DCRA, Oct 2021

DOD Climate Adaptation Plan

- **Spurred by EO 14008, Section 211, issued 27 January 2021**
- **Signed by SECDEF 1 September 2021**
- **Released by White House 7 October 2021**
- **Topline Messages:**
  - Climate change is a serious threat to our security. It impacts our missions, plans, and capabilities and must be met by ambitious, immediate action.
  - The Department is responding to climate change in two ways: adaptation to enhance resilience to the effects of climate change; and mitigation to reduce greenhouse gas (GHG) emissions.
  - The Department is showcasing its bold steps with its Climate Adaptation Plan (CAP), which is intended to drive transformative change across the entire Department.
- **DoD Climate Spotlight: https://www.defense.gov/Spotlights/Tackling-the-Climate-Crisis/**



https://media.defense.gov/2021/Oct/07/2002869699/-1/-1/0/DEPARTMENT-OF-DEFENSE-CLIMATE-ADAPTATION-PLAN-2.PDF

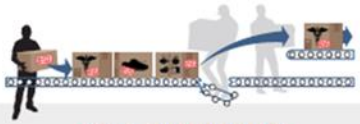
CAP Strategic Framework

5 LINES OF EFFORT (LOEs) reflect the scope and scale of DOD's adaptation and resilience efforts:

LOE 1: CLIMATE-INFORMED DECISION-MAKING

LOE 2: TRAIN AND EQUIP A CLIMATE-READY FORCE

LOE 3: RESILIENT BUILT AND NATURAL INFRASTRUCTURE

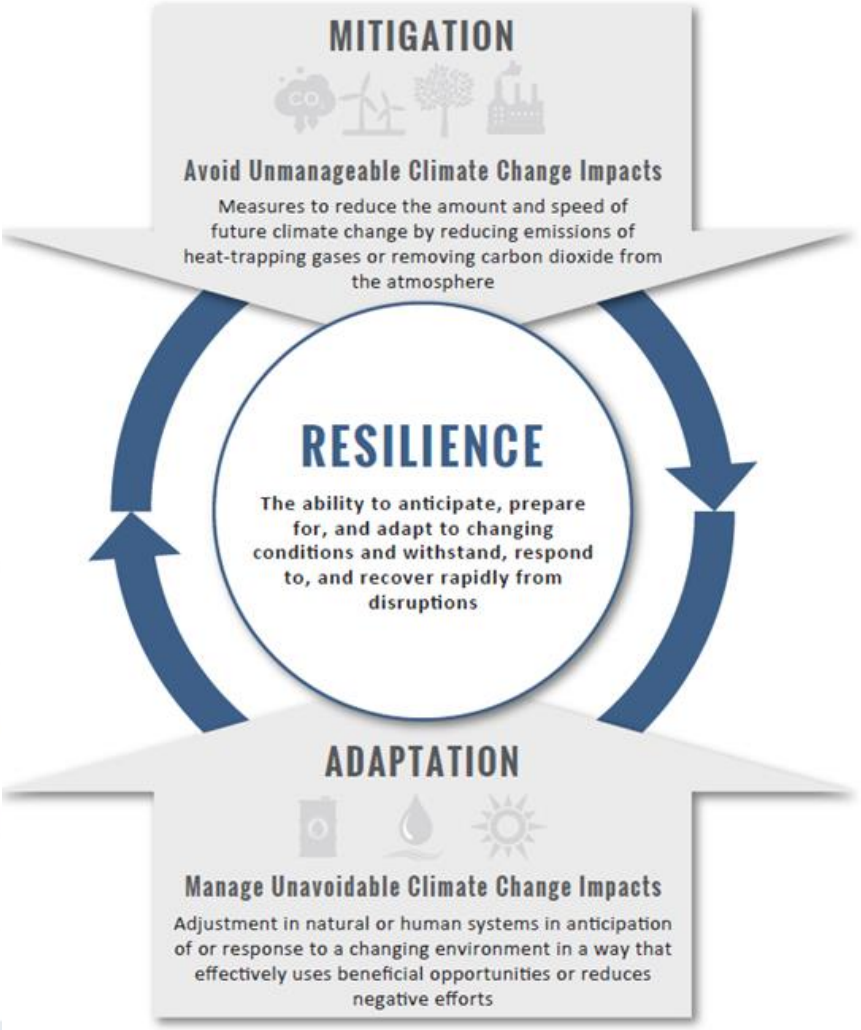


LOE 4: SUPPLY CHAIN RESILIENCE AND INNOVATION

LOE 5: ENHANCE ADAPTATION AND RESILIENCE THROUGH COLLABORATION

4 ENABLERS crosscut all five Lines of Effort:

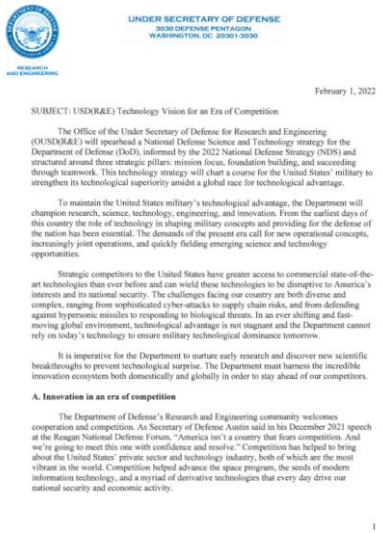
- Continuous Monitoring Data Analytics
- Aligning Incentives to Reward Innovation
- Climate Literacy
- Environmental Justice



END STATE: The above five Lines of Effort and four enablers are to ensure that DOD can operate under changing climate conditions, preserving operational capability and enhancing the natural and man-made systems essential to the Department's success.

Innovation - New Aspirations & Investment

- **USD(R&E) Technology Vision for an Era of Competition**
- **Three strategic pillars:**
  - Mission focus
  - Foundation building
  - Succeeding through teamwork



UNDER SECRETARY OF DEFENSE
3030 DEFENSE PENTAGON
WASHINGTON, DC 20301-3030

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.

- **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

Innovation - Operational Energy

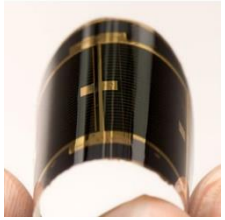
Operational Energy Capability Improvement Fund (OECIF)
Operational Energy Prototyping Fund (OEPF)

OECIF

- Highly successful program with over **75%** successful transition rate out of S&T for 96+ projects
- Advanced technology demonstrations focused on powering the force, electrifying the battlespace, and commanding energy
- Established in 2012 and highlighted in FY2021 NDAA

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

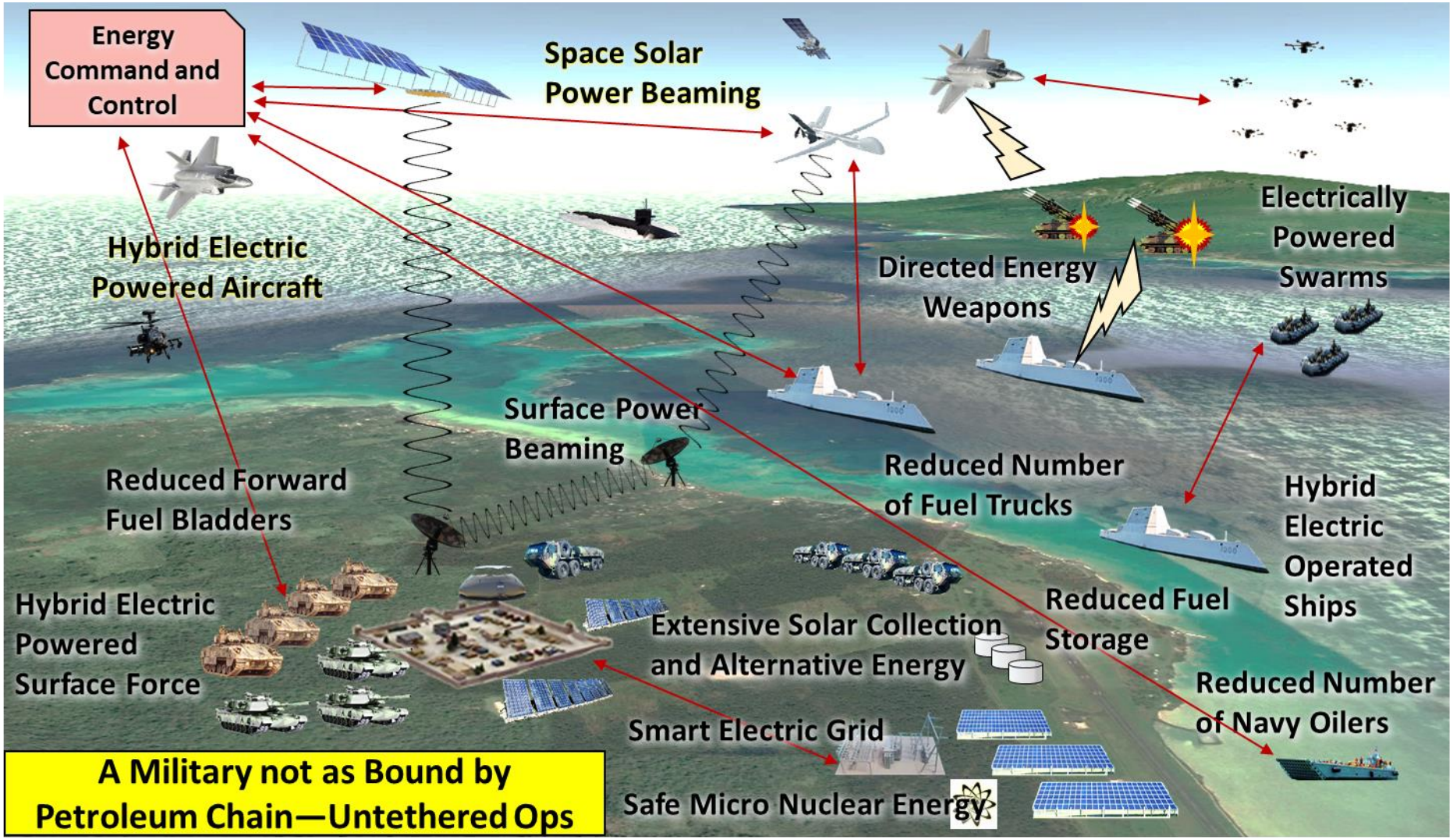

DoD Science and Technology Operational Energy Strategy Focus Areas

- Powering the Force—Improving energy generation and energy maneuver to all fixed and mobile platforms while reducing vulnerability and carbon emissions
- Electrifying the Battlespace—Delivering revolutionary energy capabilities while reducing energy, logistics and climate challenges for the warfighter of tomorrow
- Commanding Energy—Creating energy awareness throughout the entire force, supporting Joint All-Domain Command and Control (JADC2), developing near real-time energy awareness, and providing energy command & control at all levels

Calls for Proposals and Submission Timeline for FY23

- 5 May 22 – Call for Proposals
- Topic 1 – Aviation Efficiencies OECIF
  - 1st week of August – CCMD and SEO review
  - 1st week of September – Due to OE-Innovation Office
- Topic 2 – Contested Logistics (Emphasis on Energy C2, and Power Beaming) and OEPF
  - 1st week of Nov – CCMD and SEO review
- Topic 3 – Hybrid and Electric Vehicles OECIF with DIU
  - 1st week of Feb – CCMD and SEO review
  - 1st week of March – Due to OE-Innovation Office/DIU
  - 1st week of December – Due to OE-Innovation Office

Future Energy Operations



Innovation – Environment and Resilience

Strategic Environmental Research and Development Program (SERDP)
Environmental Security Technology Certification Program (ESTCP)

SERDP
DOD • EPA • DOE

- **Highly Successful S&T Program with track record of providing S&T foundations to overcome DoD's toughest environmental challenges.**
- Research investment focused on DoD unique, large cost, and risk issues
- Established in 1991 (10 U.S.C. Section 2901 – 2904), DoD, DOE, EPA partnership

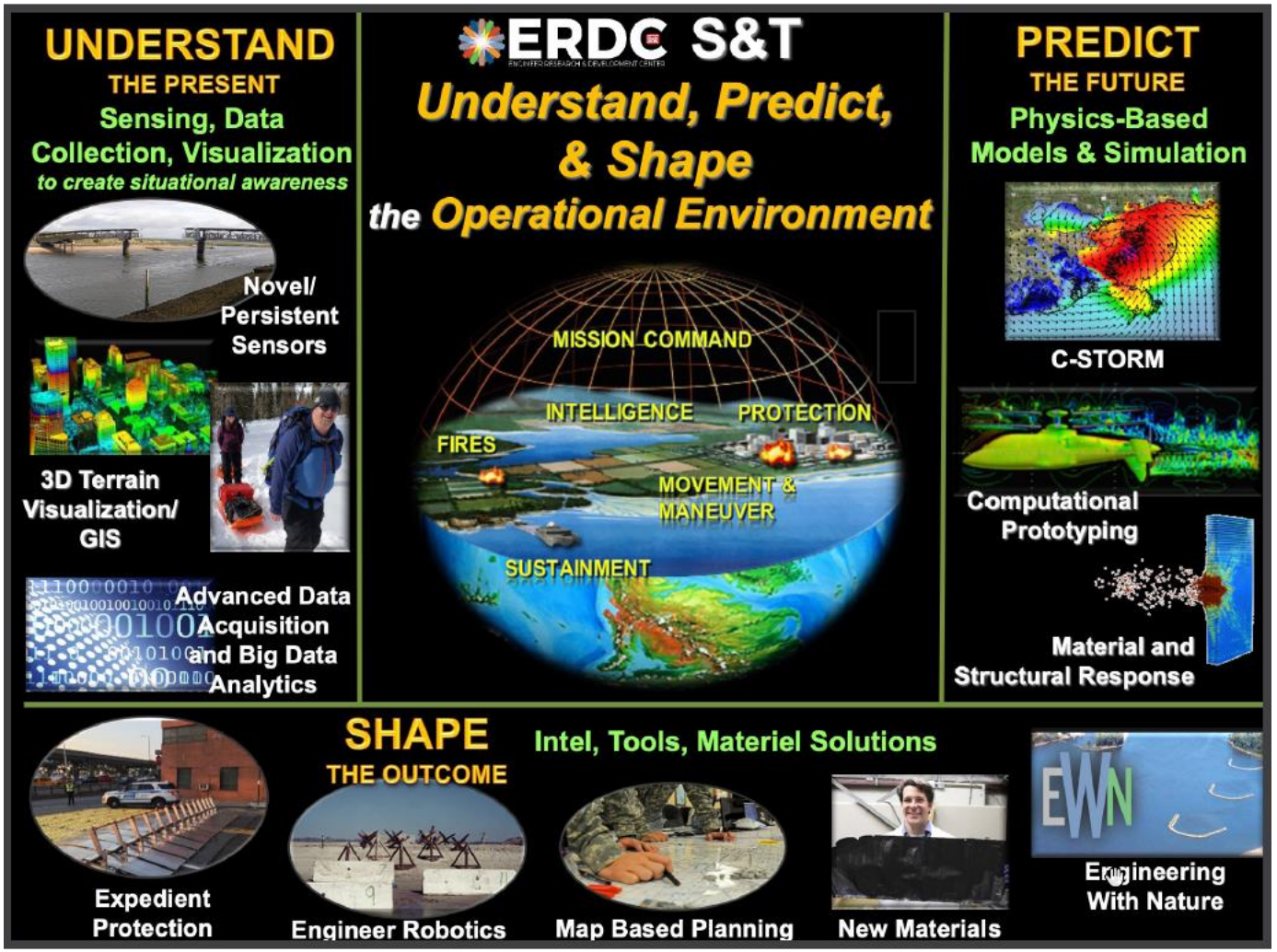
ESTCP

- **Track record of demonstrating innovative and cost-effective environmental and energy technologies**
- Transitions technology out of the lab and into DoD Infrastructure; Capitalize on past investment
- Built to promote implementation through social and regulatory acceptance in the broader community.

Increasing investment in Installation Infrastructure, Energy and Water Resilience

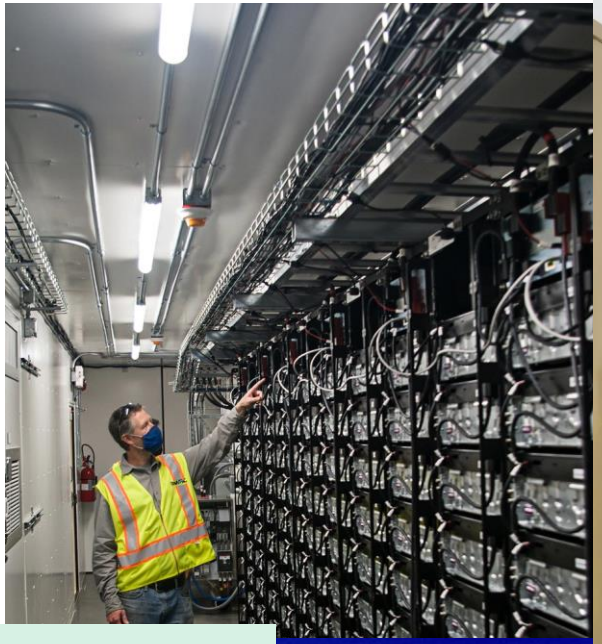
Recent Successes: PFAS detection and remediation technologies, alternative AFFF formulations, enhanced military land access, analysis of sea level rise on defense assets, infrastructure response to climate change especially in Pacific and Arctic, energy resilience and cybersecurity, corrosion prevention and repair.

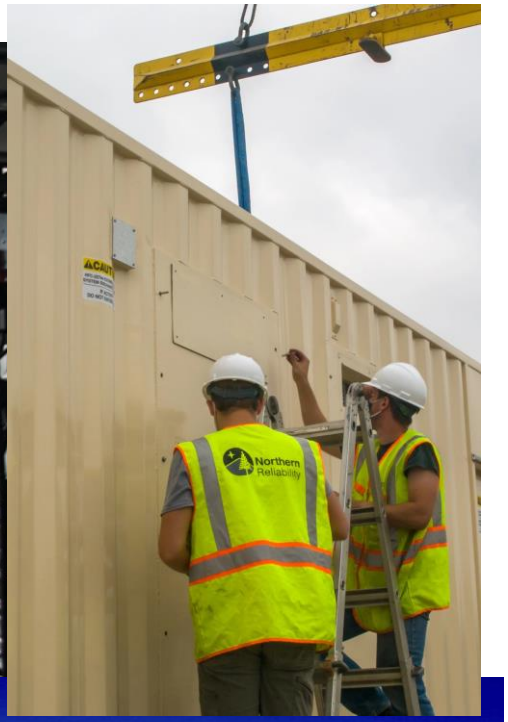
Engineer Research and Development Center

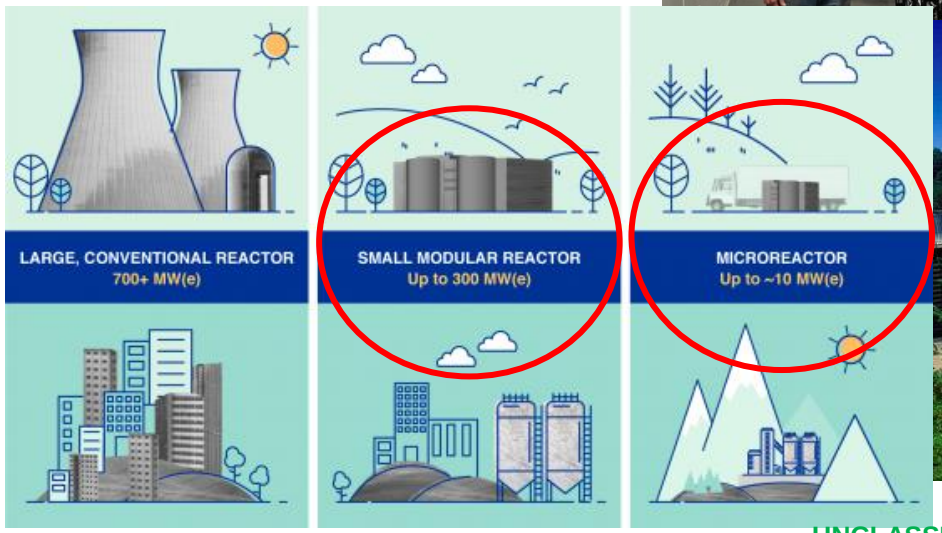


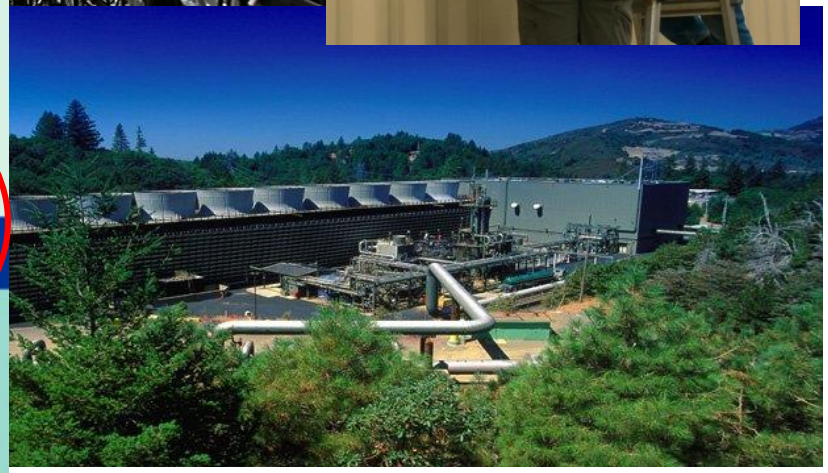
Innovative Installation Resilience Technologies Needed

- Micro-grids
- Large scale battery storage
- SMRs
- Next generation geothermal










and resilient
The country that wins the race to the clean energy future – wins.
-Unknown
(Richard Kidd)