



# ENERGY ACADEMIC GROUP

## NAVAL POSTGRADUATE SCHOOL

Energy Issues and Perspectives

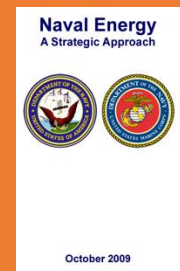
RADM Sinclair M. Harris, USN Retired

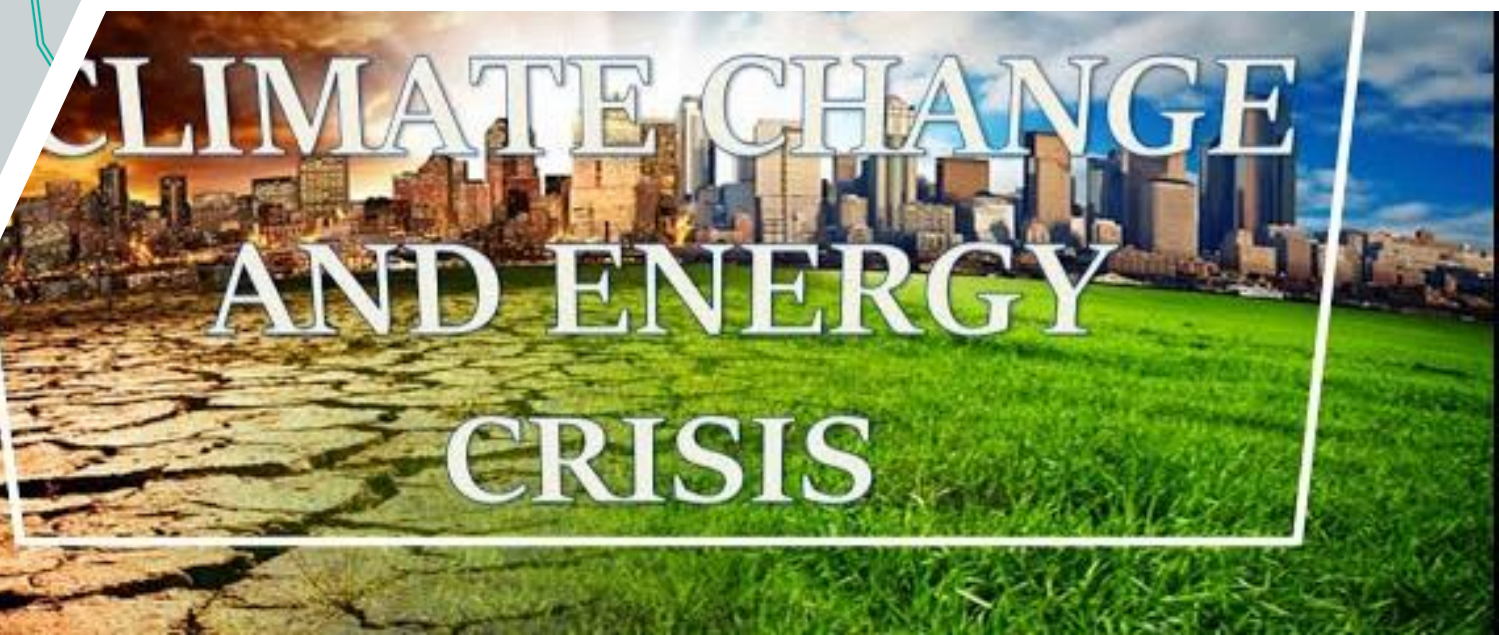
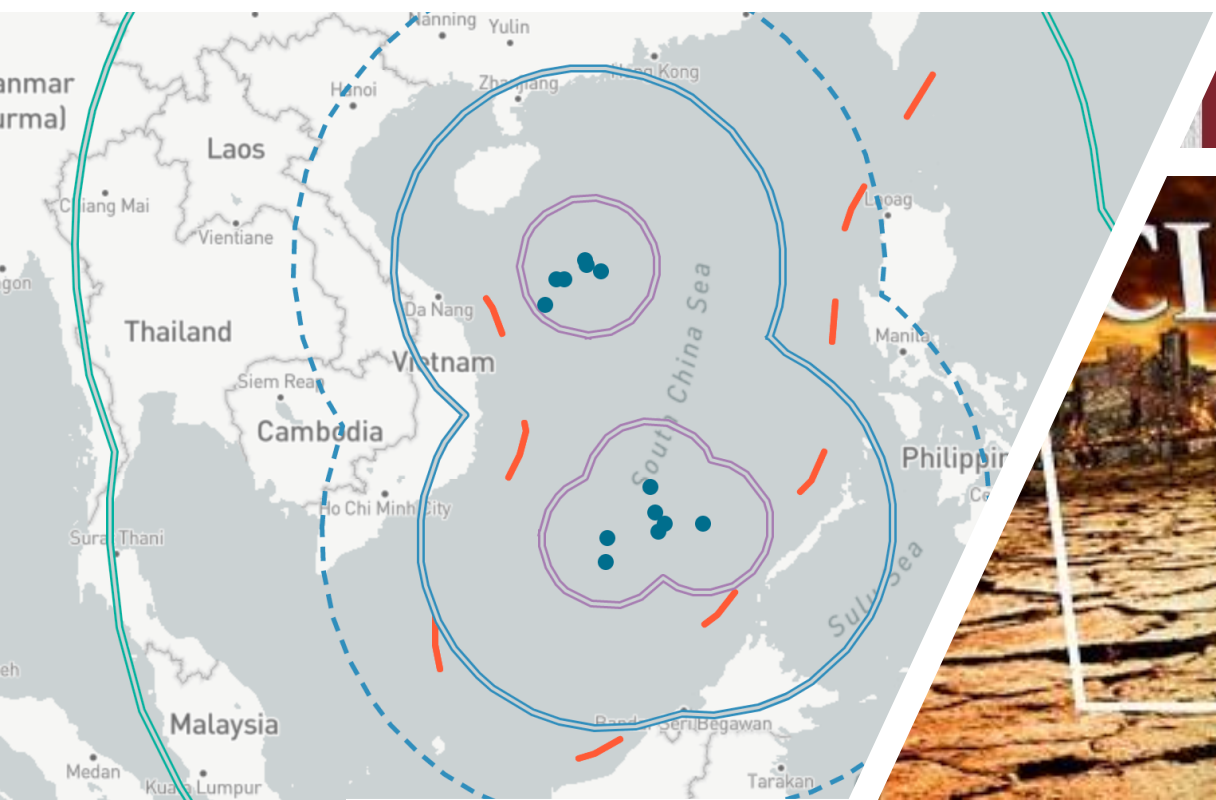
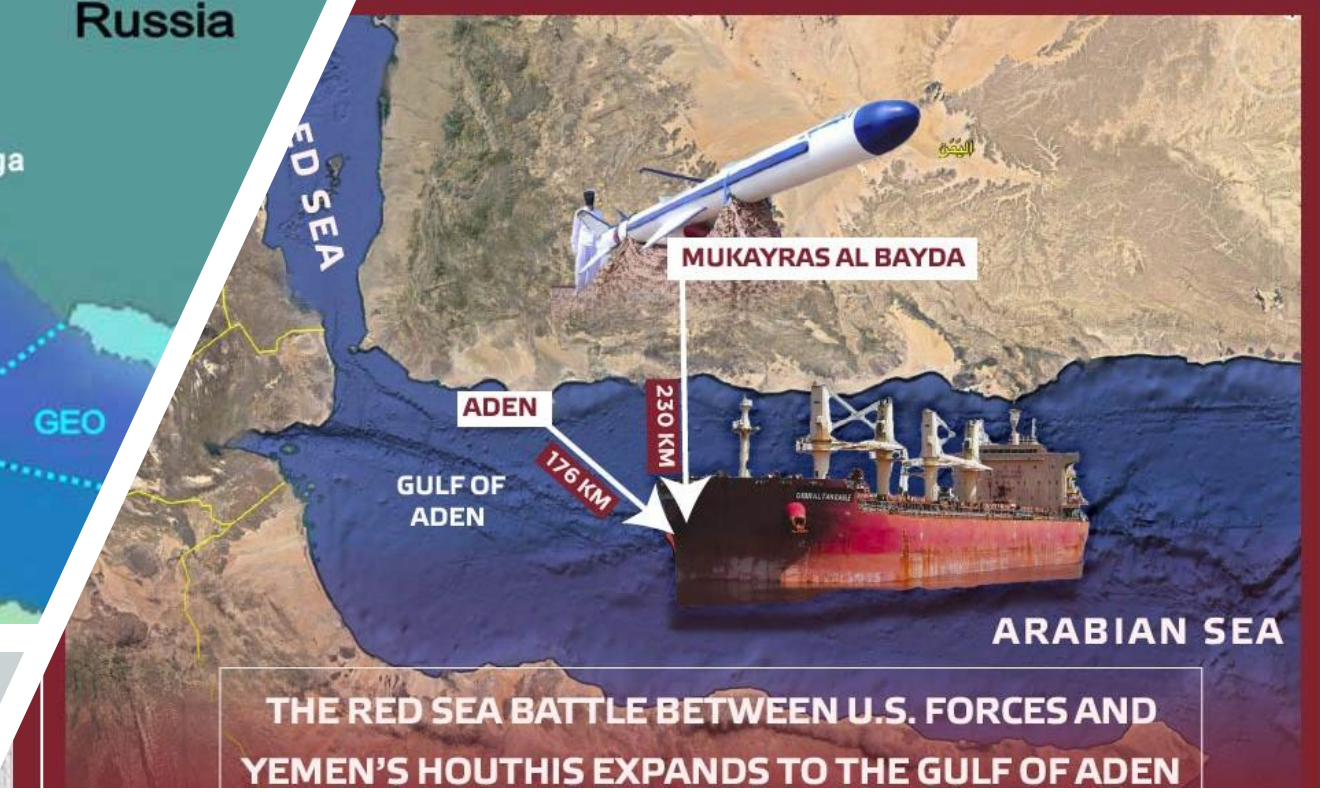
August 2024



“The Department of Navy's current energy demand creates multiple vulnerabilities for tactical platforms. Ships, aircraft, and ground vehicles must frequently receive new supplies of fuel. At sea, ships are most vulnerable alongside an oiler during underway replenishment.”

- Office of Naval Research - *Naval Energy A Strategic Approach October 2009*

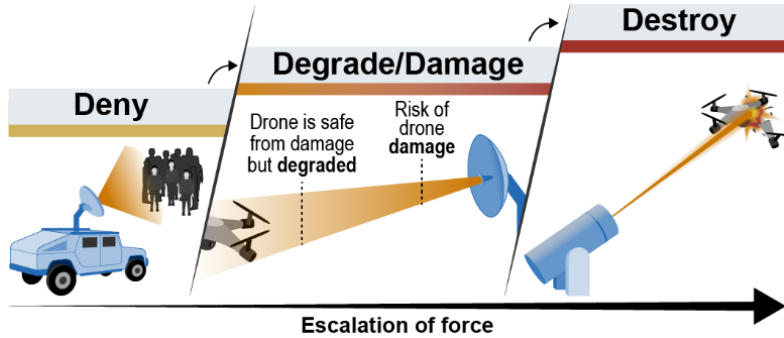
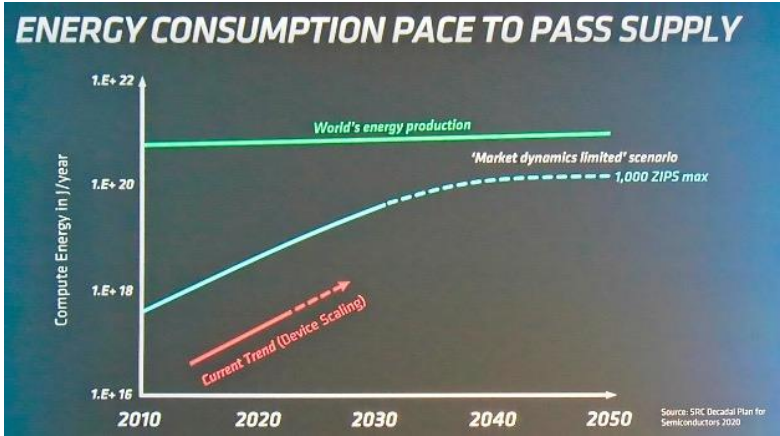
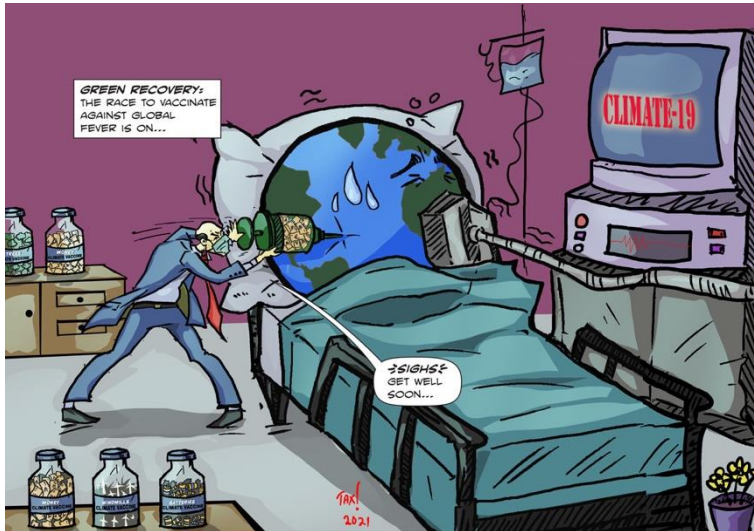
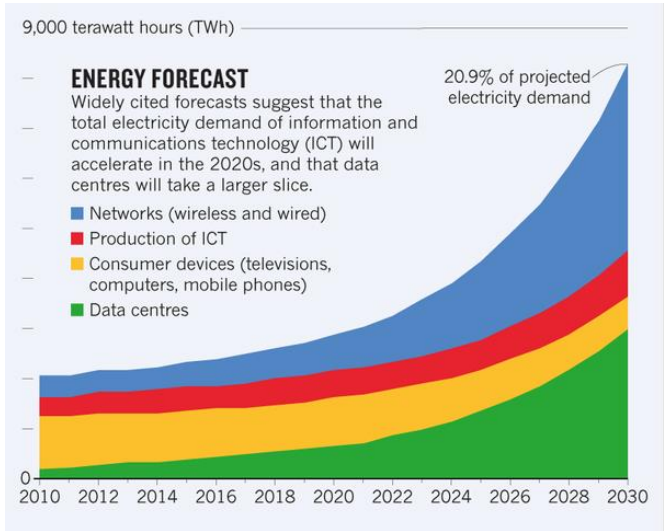




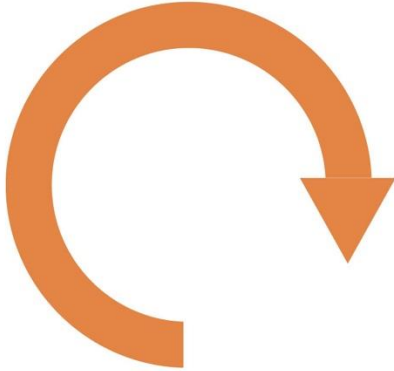
CONNECTED AND COMPLEX AND **CONTESTED**



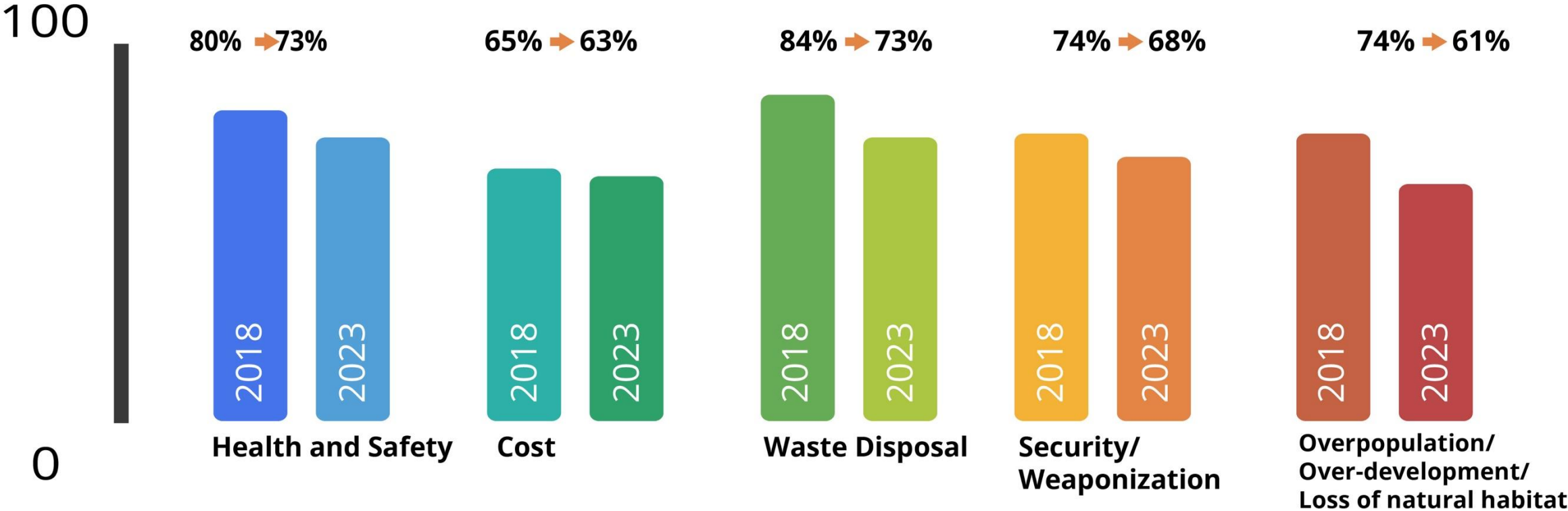
# Energy is the key and the challenge



# Americans' concerns about nuclear energy have dropped in the face of the energy crisis and climate change.



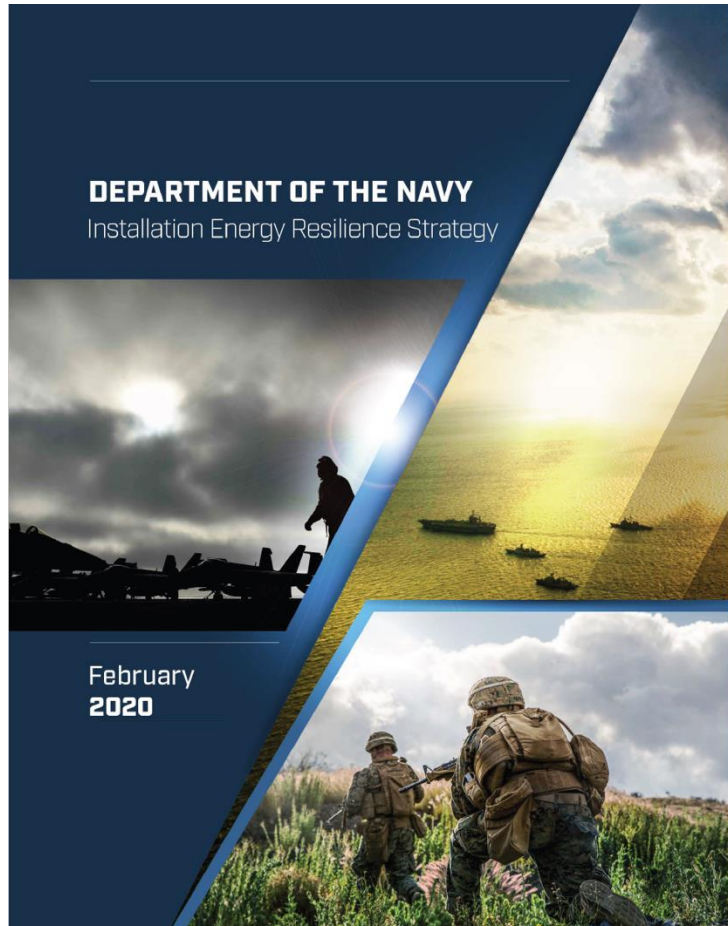
Survey question: People have concerns about upgrading nuclear energy. Which of the following make you concerned? "A lot" and "some" — +/- 3% error margin. Data from ecoAmerica report "American Climate Perspectives Survey 2023."



# Energy Topics...Too many to name them all

- Energy Policies and Strategies
- Energy demands
- Energy weapons
- Energy for Uncrewed Systems
- Developments in Fusion and Nuclear Energy
- Red Hill Closure
- Does the “Hub and Spoke” model meet demands for a distributed force?

# Energy Resilience Strategy



**VISION:** Assured energy whenever and wherever it's required to enable mission accomplishment.

**PURPOSE:** To align the Department's leadership, from top to bottom, on the objective of achieving assured energy at our installations, in the quantity and of the quality we require to accomplish required missions.

Successful implementation of this strategic intent will require mission owners and stakeholders far beyond the traditional energy and utilities management community to work together to understand and address critical energy requirements with a sense of urgency. Installation-level leaders will need to engage surrounding communities who are a vital part of the mission assurance equation.

.....  
"A revolutionary transformation is unfolding in front of us. New generations of directed energy weapons, artificial intelligence, vehicles, sensors, cyber forces, and robots are being fielded. Energy is replacing kinetics as the foundation of these new weapons systems. The quality of electricity will matter too – the Department of Navy (DON) future infrastructure, weapons systems, and communications will be controlled by systems sensitive to fluctuations in voltage or frequency." – Honorable Lucian Niemeyer, Acting Assistant Secretary of the Navy (Energy, Installations and Environment)  
.....



# Warfighting, Warfighters and the Foundation



The NDS, released in February 2018, acknowledged threats to the dominant superiority enjoyed for decades by the United States in every operating domain. Our armed forces could deploy when we wanted, assemble where we wanted, and operate how we wanted. This is no longer the case.

The NDS identified the re-emergence of long-term, strategic competition between nations that challenge our military advantage and create risks, two of which specifically guide this strategy, our assessment of, and need to prioritize installation and energy resilience:

**1. The homeland is no longer a sanctuary.** America is a target, whether from terrorists seeking to attack our citizens; malicious cyber activity against personal, commercial, or government infrastructure; or political and information subversion. During conflict, attacks against our critical defense, government, and economic infrastructure must be anticipated.

**2. Today, every domain is contested - air, land, sea, space, and cyberspace.**

The risks and vulnerabilities present in today's operating environment did not exist a decade, or even five years ago. Today's security environment is defined by rapid technological change and challenges from adversaries in every operating domain. While concerns in the past focused primarily on natural impacts to our installations, today the range of threats, both natural and man-made, are broader. They represent a growing, complex, and ever more demanding challenge to installation resilience.

The threats are multi-domain and multi-dimensional, present in the physical and virtual operating environments. This has created a requirement to continually assess the impact these risks place on naval forces' ability to accomplish



This strategy establishes the DON's priorities to align actions that address these threats, thereby ensuring naval installations, the platforms from which we generate and project naval power, are able to withstand an ever-growing range of risks. This strategy guides us to make difficult choices that prioritize competing resilience requirements.

This document is the cornerstone in a series of plans intended to enhance and improve installation resilience. We intend to publish subsequent plans that build on the foundation established here and broaden the Department's focus to address: cybersecurity, water, and environmental resilience.

**"The Department is tackling installation resilience challenges holistically across contingency operations, energy and water, data and network, controls system cybersecurity, physical security, and environmental resilience."**

*- Honorable Lucian Niemeyer, Acting Assistant Secretary of the Navy (Energy, Installations and Environment)*



The Shore is where naval combat power is developed, built and maintained; it is where we train and equip Sailors and Marines towards a unified goal of "ever-improving and innovating capability to project lethal power from the sea" (reference DON Business Operations Strategy 2019-2021). It is where readiness begins and ends. Resilient military power ensures the Navy and Marine Corps are able to fulfill their mission to the American people of providing security for the nation.



and Task Critical Assets and Infrastructure and enable mission execution.

The following energy security principles apply to all DON installations and activities. All infrastructure facility projects will address energy resiliency, reliability, and efficiency in project development, planning, design, and construction.

1. Installation Commanders and Installation Energy Managers shall assess and account for the quantity and quality of power needed for core mission functions, in full consultation with mission owners and Mission Assurance representatives.
2. Installation Energy Plans (IEPs) shall be the primary tool to identify requirements to enhance energy resiliency for mission critical assets and prioritized projects enabling mission capabilities.
3. IEPs shall account for the power and transmission demands needed to support the introduction of new weapons systems.
4. IEPs will consider the consultative input of local utilities and other service providers to increase and extend energy resilience beyond the installation fence line.
5. The DON pursues enhanced and secure power generation to support installation missions using whichever fuel/energy source is the most economical, available, and resilient.

In 2017, the DON published an Energy Security Framework (ESF) to focus on closing these gaps. It emphasized three primary objectives to enhance mission assurance through assured energy, defining benchmarks for: resiliency, reliability, and efficiency necessary for installations to enable assured missions. This strategy reinforces those goals:

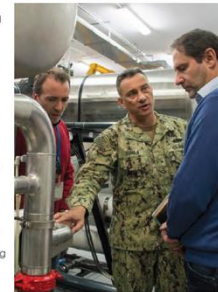
**Goal 1: Resiliency** - Increase energy resiliency for Defense and Task Critical Assets and Infrastructure to ensure continuity of mission while minimizing vulnerable fuel supply chains.

**Goal 2: Reliability** - Improve assured access to reliable and quality energy for Defense and Task Critical Assets and Infrastructure and enable mission execution.

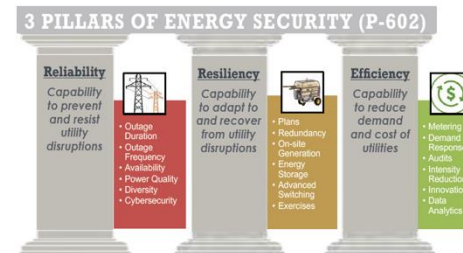
**Goal 3: Efficiency** - Increase energy efficiency to extend operational durations for Defense

Critical Assets and Infrastructure gaps, and address mission critical vulnerabilities. Publish and implement an energy exercise plan for every installation by September 2023.

**5. Invest in Energy Reliability, Resilience, and Efficiency.** Starting in Program Objective Memorandum (POM) 2022, program and budget resources necessary to efficiently meet and sustain energy reliability and resilience to all Defense and Task Critical Assets and Infrastructure by 2030.



The Department must optimize the use of every available authority to accelerate delivery of secure and reliable energy. See Appendix A for Navy and Marine case studies highlighting the process for developing and deploying integrated energy solutions at their installations. Appendix B contains a compilation of Energy Mandates and Appendix C summarizes enabling authorities for installation energy security.



For decades, the DON has been a leader in energy management, innovation, and industry partnerships. We have published this strategy to provide leaders and energy managers at every level with clear goals and metrics to guide continued resiliency initiatives at our Navy and Marine Corps installations. The following appendices list resources, look, and programs the DON is using to enhance its energy security posture. The intent of these sections is to provide information and mechanisms for energy personnel to leverage in order to advance goals of the DON for resiliency and efficiency. Now is the time for us to come together and act with a sense of urgency in the relentless pursuit of the installation resilience necessary to meet the increasing mission demands for high quality energy in our current and future operational environments.

**LET'S GO DO IT!**



# View from the Hill

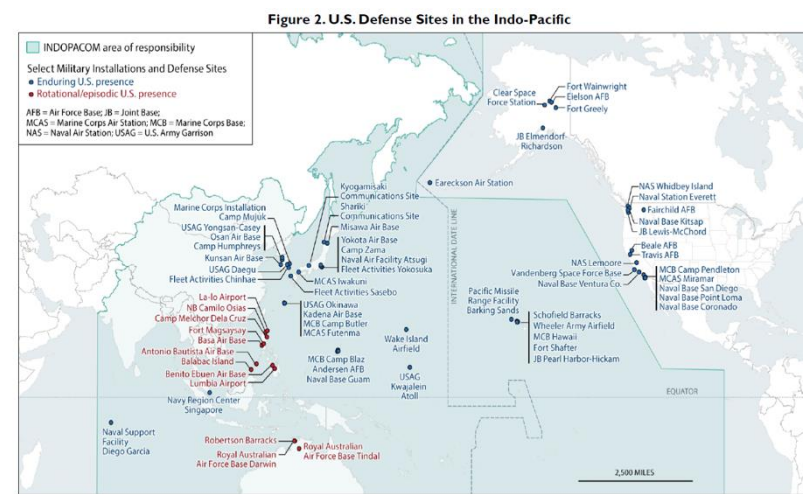


## U.S. Defense Infrastructure in the Indo-Pacific: Background and Issues for Congress

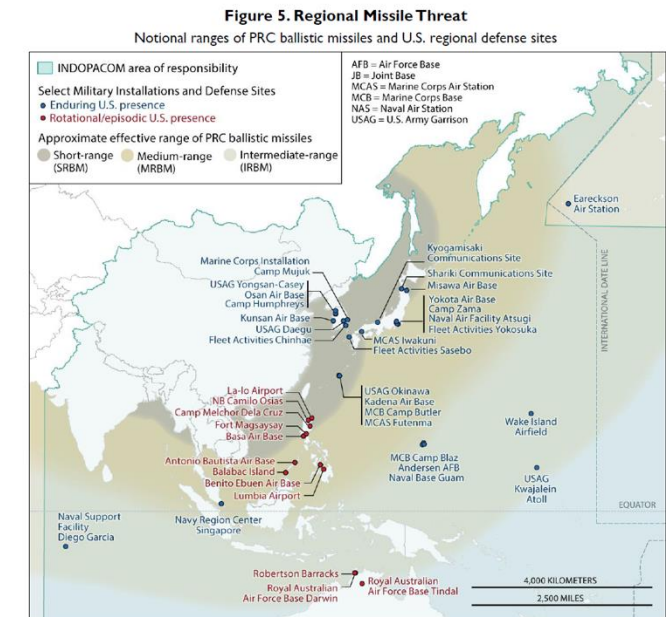
June 6, 2023

### Indo Pac Infrastructure Supports:

- Basing of personnel and weapons systems
- Domain awareness and area defense
- Maintenance and repair
- Training and Exercises
- Storage, prepositioning, and distribution of equipment and supplies
- Research, development, test, and evaluation (RDT&E).



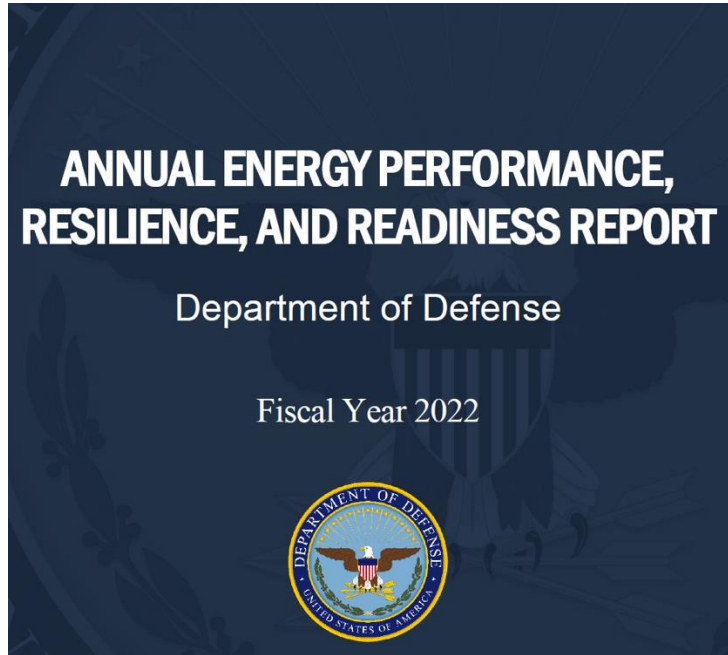
Source: CRS graphic based on analysis of DOD information, including the "FY2022 Base Structure Report," installation and unit web pages, and related documentation.  
 Notes: Naval Communications Station Harold E. Holt (located near Exmouth, Australia) is not depicted due to space constraints.



Source: CRS graphic based on PRC missile data and analysis from "Missiles of China," Center for Strategic and International Studies Missile Threat Project, April 12, 2021, at <https://missilethreat.csis.org/country/china> and CRS analysis of DOD basing data.  
 Notes: Ranges are notional.

How resilient are the energy resources to support operations?

# Defense Wide Demands



The 2022 *National Defense Strategy* (NDS) set the policy direction for the Department’s energy efforts by making “reducing energy demand a priority,” and directing the Department to “adopt more efficient and clean-energy technologies that reduce logistics requirements in contested or austere environments.”<sup>3</sup> [In addition, the President and the Secretary of Defense have directed the DoD to ensure installations and](#) – kinetic, cyber, and natural – and that the strategic use of energy promotes the readiness of the armed forces for their military missions.

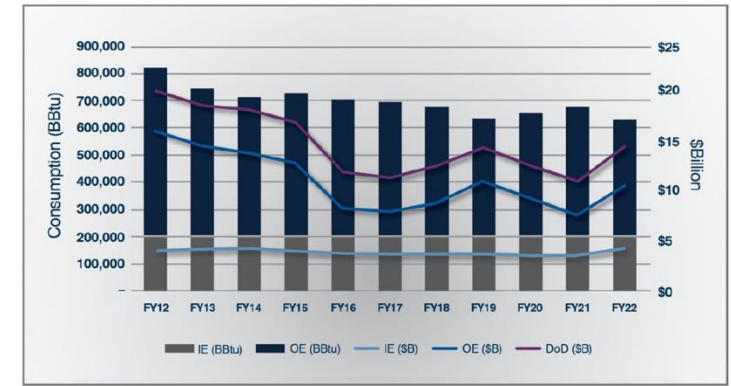


Figure 2. DoD’s Total Energy Consumption and Cost (FY12 - FY22)

Within DoD, the Department of the Air Force (DAF) was the largest consumer of operational energy in FY22, followed by the Navy and USMC, and Army (Left, Figure 3). The Army was the largest consumer of installation energy in FY22, followed by the Navy and USMC, DAF, and the Defense Agencies (Right, Figure 3).

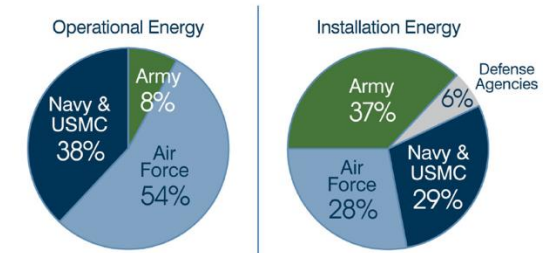


Figure 3. DoD Percentage of Energy Consumption for OE and IE by Service (FY22)

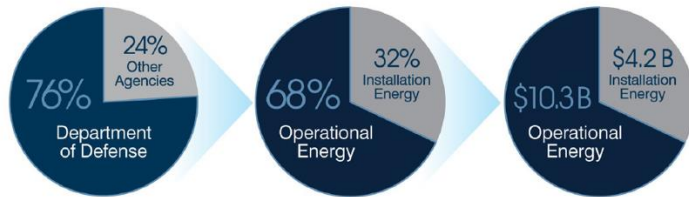


Figure 1. DoD Total Energy Consumption as the Percentage of Federal Total, DoD Percentage of Total Energy Consumption for OE and IE, and DoD Total Energy Cost in Billions for OE and IE (FY22)

DoD’s installation energy consumption mix mirrors that of the U.S. commercial sector, where natural gas and electricity dominate the supply mix (Figure 4).<sup>7</sup>

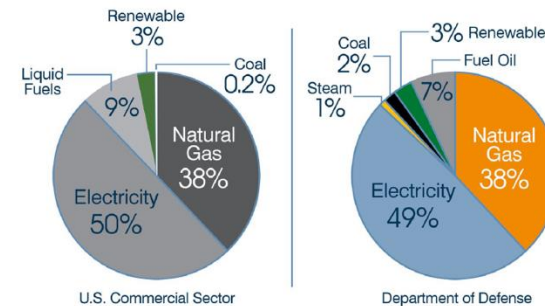



Figure 4. U.S. Commercial Sector vs. DoD’s Installation Energy Consumption Mix, FY22

# Alternative Energy

UNCLASSIFIED



## Renewable Energy


From 10 U.S.C. § 2911(g):

It shall be the goal of the Department of Defense to produce or procure not less than 25 percent of the total quantity of facility energy it consumes within its facilities during fiscal year 2025 and each fiscal year thereafter from renewable energy sources, and to produce or procure facility energy from renewable energy sources whenever the use of such renewable energy sources is consistent with the energy performance goals and energy performance master plan for the Department.

From 10 U.S.C. § 2924:

Renewable energy sources include solar, wind, biomass, landfill gas, ocean, municipal solid waste, and new hydroelectric generation.

**In Fiscal Year 2022, 15.9 percent of DoD's facility energy was produced or procured from renewable energy sources.**




May 2023

UNCLASSIFIED

6

UNCLASSIFIED



## Renewable Energy (continued)


- DoD pursues renewable energy to support and advance installation energy resilience while also complying with legal requirements to increase its renewable energy supply.
- DoD continues to invest in cost effective renewable energy solutions such as solar photovoltaic (PV), wind, and geothermal technologies.
- DoD focuses renewable energy investments at locations where the greatest energy resilience improvement and green-house gas emissions reduction can be achieved, often at the lowest cost.
- Four bases supporting nuclear deterrence missions have onsite solar PV arrays, although not all onsite generation capacity can currently provide power directly to base infrastructure independent of the grid.

May 2023

UNCLASSIFIED

7

UNCLASSIFIED



## Natural Gas


- Natural Gas is a key primary fuel source for many DoD bases, including bases which support nuclear deterrence missions. Natural Gas comprises 38% of DoD's total installation energy consumption.
- Natural Gas supplies approximately 42% of facility energy consumption for DAF bases supporting nuclear deterrence missions and 40% of facility energy consumption for DON bases supporting nuclear deterrence missions, based on Fiscal Year 2021 Annual Energy Management and Resilience Report data.
- Planned natural gas projects at bases supporting nuclear deterrence missions include a microgrid incorporating a natural gas combined heat and power plant and upgrades to natural gas distribution systems.

May 2023

UNCLASSIFIED

9


UNCLASSIFIED



## Fixed Microreactor Demonstration

Microreactors offer the potential to enhance installation energy resilience and mission assurance. DoD is planning to demonstrate a Nuclear Regulatory Commission (NRC)-licensed microreactor at Eielson Air Force Base, Alaska.

- DoD envisions using authority under 10 U.S.C. § 2922a to enter into a contract with a commercial entity which will own and operate the reactor.
- DoD issued a Request for Proposals in September 2022.
- Vendor selection is in progress with an expected award in 2024 and commercial operational possible by 2027.
- DoD is evaluating the suitability of microreactors for potential use at other installations.




May 2023

UNCLASSIFIED

10

UNCLASSIFIED



## Summary

- Installation Energy Plans and Energy Resilience Readiness Exercises help installations assess mission readiness and potential gaps in energy resilience.
- Natural Gas is, and will continue to be for the near future, a key primary fuel source for bases supporting nuclear deterrence missions.
- On-site generation, including back up generators and renewable technologies, provides redundant secondary sources of power to ensure critical mission continuity.
- Increased use of microgrids incorporating energy storage will further enhance energy resilience.
- Emerging technologies, such as microreactors, will be evaluated for suitability as they become commercially available.

May 2023

UNCLASSIFIED

11

# Energy and Information Warfare

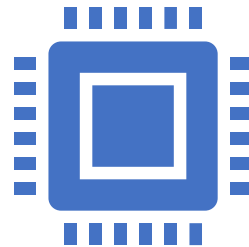
- Quantum Mechanics – How things work together
- Data Analytics
- Digital Transformation and Networking
- Digital Twins for everything



# For your consideration...



Nations go to war over energy or are held hostage by lack of access. ***How is this factored into our strategic plans and capabilities?***



New technologies like artificial intelligence, quantum computing and supercomputers demand HVAC and power resources. ***How will expeditionary forces be able to provide it to the distributed force and warfighters on the forward edge of technology?***



Changes in climatic conditions, sea level rise and warming continue to impact every corner of the globe. The world population also continues to grow. ***How will the growing energy demands be met?***