NARUC
National Association of Regulatory Utility Commissioners

Regulatory Considerations for Utility Investments in Defense Energy Resilience

Prepared for the National Association of Regulatory Utility Commissioners
Prepared by Converge Strategies, LLC

October 2021

Regulatory Considerations for Utility Investments in Defense Energy Resilience

Prepared by
Converge Strategies, LLC

Prepared for
National Association of Regulatory Utility Commissioners

Disclaimer

This material is based upon work supported by the U.S. Department of Energy, Office of Cybersecurity, Energy Security, and Emergency Response, under Award Number DE-OE0000818.

Acknowledgments

The authors of this paper are Wilson Rickerson, Erin Brousseau, Meredith Pringle, Jonathon Monken, Jack Graul, Tom Calvert-Rosenberger, and Jack Barker from Converge Strategies, LLC. The authors would also like to gratefully acknowledge the input and feedback from the project Advisory Group. The paper benefited substantially from their expertise and guidance:

- **Lorraine Akiba**, LHA Ventures
- **John Gavan**, Colorado Public Utilities Commission
- **Andrew Fay**, Florida Public Service Commission
- **Darcie Houck**, California Public Utilities Commission
- **Matthew Dale**, Virginia State Corporation Commission
- **Laura Schepis**, Edison Electric Institute
- **Robert Jeffers**, Sandia National Laboratories
- **Jennifer Kallay**, Synapse Energy Economics
- **Rick Mroz**, Resolute Strategies
- **Kunal Thaker**, Idaho National Laboratory
- **William Van Houten**, U.S. Department of Defense, Office of Local Defense Community Cooperation

The authors would also like to thank Will McCurry, Danielle Sass Byrnett, and Lynn Costantini from NARUC, and Johanna Zetterberg, Michael Coe, and Rebecca Asch from the U.S. Department of Energy for their leadership and guidance.

The authors would like to thank the following individuals for their insights and expertise: Ryan Anderson (Tucson Electric Power), Scott Aaronson (Edison Electric Institute), John Baxter (The Concourse Group), Shannon Bergt (U.S. Army Garrison Detroit Arsenal), Khojasteh Davoodi (U.S. Navy Utility Rates and Studies Office), Campbell Delahoyde (NASEO), Robert Hanson (Lawrence Livermore National Laboratory), David Irwin (U.S. Army Office of Energy Initiatives), Christopher Lindsey (Tucson Electric Power), David McGeown (McGeown Associates), Alex Morese (Michigan Public Service Commission), Margit Myers (U.S. Department of Defense Office of Local Defense Community Cooperation), Kirstin Punu (AES), Eric Raatz (Tucson Electric Power), Paul Stockton (Paul N Stockton LLC), Lariza Sepulveda (U.S. General Services Administration), Kirsten Verclas (NASEO), Doyace Wilson (Tucson Electric Power), and Michael Wu (Converge Strategies, LLC).

Table of Contents

Acronyms and Definitions . . . 3
Executive Summary . . . 5
Introduction . . . 8
1. DoD Reliance on Civilian Power Grids . . . 10
    1.1. Threat Environment . . . 11
2. Defense Energy Resilience Background . . . 13
    2.1. The FAST Act of 2015 and DCEI . . . 13
    2.2. Critical Infrastructure Inside and Beyond the Fence Line . . . 14
3. DoD Energy Resilience Background . . . 16
    3.1. DoD Energy Background and Organization . . . 16
    3.2. DoD Regulatory Intervention . . . 17
    3.3. DoD and Utilities . . . 17
    3.4. DoD Energy Policy . . . 19
4. Ongoing Efforts Related to Defense Energy Resilience Investment . . . 21
    4.1. DoD–DOE Memorandum of Understanding . . . 21
    4.2. DOE Programs . . . 21
    4.3. DoD Programs . . . 22
    4.4. Utility Industry Programs . . . 24
    4.5. State Government Programs . . . 25
5. Case Studies . . . 26
    5.1 Pacific Missile Range Facility Barking Sands (Kaua'i, Hawaii) . . . 26
    5.2. Davis-Monthan Air Force Base (Tucson, Arizona) . . . 28
    5.3. Detroit Arsenal Regional Defense Assessment of Resilience . . . 30
6. Emerging Issues for Regulators . . . 32
    6.1. Rate Recovery—Who Pays? . . . 32
    6.2. How to Weigh Benefits . . . 33
    6.3. Utility and DoD Collaboration . . . 38
    6.4. Secure Communications and Decision Making . . . 38
    6.5. Cybersecurity and Utility-Military Cooperation . . . 39
7. Next Steps . . . 41
References . . . 43
Appendix A. Defense Critical Infrastructure Policy Background . . . 53
Appendix B. Commissions that Regulate Cooperative Utilities . . . 54
Glossary of Terms . . . 55

Acronyms and Definitions

ACC	Arizona Corporation Commission
AHA	All Hazards Analysis
ASD(EI&E)	Assistant Secretary of Defense for Environment and Energy Resilience
ASD(HD&GS)	Assistant Secretary of Defense for Homeland Defense and Global Security
ASD(I)	Assistant Secretary of Defense for Infrastructure
ASD(S)	Assistant Secretary of Defense for Sustainment
ASD(SP&L)	Assistant Secretary of Defense for Sustainment for Production and Logistics
BRAC	Base Realignment and Closure Commission
CDF	Critical Defense Facility
CE	Consumers Energy
CEII	Critical Electric Infrastructure Information
CESER	Cybersecurity, Energy Security, and Emergency Response
CIP	Critical Infrastructure Protection
CISA	Cybersecurity and Infrastructure Security Agency
CMMC	Cybersecurity Maturity Model Certification
CONUS	Continental United States
CUI	Controlled Unclassified Information
DAR2	Detroit Arsenal Regional Defense Assessment of Resilience
DCEI	Defense Critical Electric Infrastructure
DCI	Defense Critical Infrastructure
DHS	U.S. Department of Homeland Security
DMAFB	Davis-Monthan Air Force Base
DNI	Office of the Director of National Intelligence
DoD	U.S. Department of Defense
DoDD	Department of Defense Directives
DoDI	Department of Defense Instructions
DOE	U.S. Department of Energy
DOE/EERE	U.S. Department of Energy Office of Energy Efficiency and Renewable Energy
DOE/OE	U.S. Department of Energy Office of Electricity
DSB	Defense Science Board
DTA	U.S. Army Garrison Detroit Arsenal
EAC	Electricity Advisory Committee
EACI	Energy Assurance for Critical Infrastructure
EEI	Edison Electric Institute
EISA	Energy Independence Security Act
ERMA	Energy Resilience for Mission Assurance
EUL	Enhanced Use Leases
FAST	Fixing America's Surface Transportation
FEMA	Federal Emergency Management Agency
FRIWG	Federal Rate Intervention Working Group

FY	Fiscal Year
GAO	Government Accountability Office
GSA	U.S. General Services Administration
HI PUC	Hawaii Public Utilities Commission
HECO	Hawaiian Electric
IEP	Installation Energy Plan
INL	Idaho National Laboratory
IOU	Investor-Owned Utility
IRP	Integrated Resource Plan
IT	Information Technology
KIUC	Kaua'i Island Utility Cooperative
MCAS	Marine Corps Air Station
MIR	Military Installation Resilience
MOU	Memorandum of Understanding
MPSC	Michigan Public Service Commission
NARUC	National Association of Regulatory Utility Commissioners
NAVFAC	Naval Facilities Engineering Command
NCBC	Naval Construction Battalion Center
NERC	North American Electric Reliability Corporation
NDAA	National Defense Authorization Act
OEA	Air Force Office of Energy Assurance
OEI	U.S. Army Office of Energy Initiatives
OLDCC	Office of Local Defense Community Cooperation
OSD	Office of the Secretary of Defense
OT	Operations Technology
PPA	Power Purchase Agreement
PPD	Presidential Policy Directive
PMRF	Pacific Missile Range Facility
PSC	Public Service Commission
PSO	Public Service Company of Oklahoma
PUC	Public Utilities Commission
RFP	Request for Proposal
SSA	Sector-Specific Agency
TEP	Tucson Electric Power
UESC	Utility Energy Service Contract
UP	Utilities Privatization
USD(A&S)	Under Secretary of Defense for Acquisition and Sustainment
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USD(I&S)	Under Secretary of Defense for Intelligence and Security
USD(P)	Under Secretary of Defense for Policy
USD(R&E)	Under Secretary of Defense for Research and Engineering

Executive Summary

Regulators are increasingly being asked to consider utility investments in defense energy resilience. Defense energy resilience investments support improvements in civilian infrastructure that serve facilities deemed critical to the defense of the United States.

DoD is increasingly vulnerable to electricity interruptions. The U.S. Department of Defense (DoD) is heavily dependent on the commercial electricity grid, and DoD's globally networked force relies on secure, reliable communications from domestic installations. Power outages at U.S. bases can significantly impact critical missions around the world. In 2020, DoD experienced hundreds of power outages lasting 8 hours or longer including at installations with missions that cannot tolerate interruptions. Natural and man-made hazards impacting critical infrastructure are also evolving at a rapid pace, resulting in a substantial increase in risk to defense energy resilience. Extreme weather events, such as hurricanes in the Southeast and wildfires in the West, have degraded or damaged DoD's ability to execute its missions. Winter storm Uri, which hit Texas in January 2021, exposed inter-utility vulnerabilities as gas pipelines failures drove electricity outages and water treatment interruptions. Sophisticated, state-sponsored cyber adversaries have also demonstrated that they possess the resources to conduct protracted and damaging attacks on critical infrastructure.

Federal law and policy call for civilian-military collaboration around energy resilience. In response to the evolving threat environment, the federal government has created new authorities for focusing on defense energy resilience. Congressional legislation in 2015 gave the U.S. Department of Energy (DOE) responsibilities to protect the civilian electric infrastructure that serves critical defense facilities. Executive Orders and Presidential Directives from the past decade have also established requirements for identifying and protecting critical infrastructure within DoD, and for ensuring the cybersecurity of infrastructure critical to national security. Policies such as these are focusing attention and effort on military-civilian partnerships related to defense energy resilience at the federal and state levels. At the same time, such policies are raising new questions about the role of utility investment and regulation in supporting national security.

DoD energy resilience policy increasingly requires utility partnership and regulatory attention. Energy resilience is a central tenet of DoD energy policy, and each of the military services have policies requiring domestic installations be able to operate independently of the power grid for 1 to 2 weeks. DoD does not have sufficient funding to achieve these targets on its own, and DoD actively works with regulated utilities to develop and finance on-site energy resilience projects. DoD is also increasingly exploring partnerships for defense energy resilience improvements "outside the fence line," that is, outside the borders of its installations. DoD will need to significantly accelerate the pace of energy resilience investment both inside and outside the fence line to meet national security requirements, and this may increase the pace of regulator engagement with national security-related projects.

DoD is a large organization, and responsibility for energy resilience and for utility partnership resides in multiple offices and at multiple levels. When regulators consider defense energy resilience projects, it is important to understand which parts of the DoD enterprise may be represented in the conversations. DoD energy resilience policy and strategy are developed by officials at the headquarters level. Energy resilience project development is frequently led by the energy program offices of each military service. Each military installation has its own staff responsible for on-base energy systems. Representatives from each of these levels of DoD may engage with regulators informally outside of regulatory proceedings. DoD staff may also appear as formal intervenors and submit testimony in rate cases or rulemaking proceedings, but when they do so they are representing the interests of the entire federal government through authority delegated by the U.S. General Services Administration (GSA).

Multiple defense energy resilience initiatives have recently been launched in parallel. Federal, state, and utility actors have launched a number of programs related to defense energy resilience within the last

two years. The DoD Military Installation Resilience program, for example, has provided grants since 2019 to communities attempting to strengthen the infrastructure that supports defense installations. Many of these grants focus on energy resilience both within and outside of the installation. The U.S. Army and the Edison Electric Institute also signed a memorandum of understanding in 2021 to develop pilots for utility-installation collaboration on resilient energy infrastructure. Programs such as these can both inform, and be integrated into, the emerging dialogue about the intersection between national security and utility regulation.

Regulatory proceedings that have taken DoD energy resilience into account can provide important lessons learned. There is an increasing number of instances in which state regulators have engaged with defense energy resilience projects. The report includes three case studies of projects that involve different types of infrastructure and focus at different scales: generation infrastructure sited on DoD land, transmission infrastructure surrounding a DoD base, and multi-utility engagement in a region containing multiple DoD installations. These case studies include:

- *Pacific Missile Range Facility (PMRF) Barking Sands (Kaua'i, Hawai'i).* The State of Hawaii Public Utilities Commission (HI PUC) approved a utility-scale solar PV and battery project that was sited on land leased from the DoD by a cooperative utility. The project provides firm renewable electricity to the power grid during normal operations and will serve the installation as an islandable microgrid during power interruptions and during mission critical operations.
- *Davis-Monthan Air Force Base (Tucson, Arizona).* The Arizona Corporation Commission (ACC) approved an environmental compatibility certificate for a planned project by Tucson Electric Power (TEP) to expand and upgrade the transmission system in the region surrounding Davis-Monthan Air Force Base. The project is being undertaken to enhance service reliability for current and new customers, and in response to DoD energy resilience policies and requirements.
- *Detroit Arsenal Regional Defense Assessment of Resilience (DAR2).* A polar vortex in January 2019 increased demand for natural gas for heating in Michigan at the same time that a fire shut down one of the state's largest natural gas storage and delivery facilities. The event and resulting supply crisis prompted the governor to direct the Michigan Public Service Commission (MPSC) to assess energy supply vulnerabilities across the state. In parallel, DoD, municipalities, manufacturing facilities, and utilities partnered to launch a joint energy resilience planning process in Michigan—through the DoD Military Installation Resilience grant program—to address gaps such as those exposed by the polar vortex. DoD is engaging the MPSC during the regional planning process.

Defense energy resilience investment raises new and complex questions for regulators. Going forward, regulators may proactively engage with issues related to defense energy resilience, or they may increasingly see issues related to defense energy resilience integrated into their normal course of business. In either case, there are several uncertainties and unresolved issues that regulators will need to navigate when considering defense-related topics. Examples of these issues include:

- *Rate recovery.* Should DoD, other federal agencies, ratepayers, or a combination of these be responsible for supporting defense energy resilience investments? How do we determine the share that each entity should contribute?
- *Ratepayer benefits.* What types of ratepayer "co-benefits" can be derived from defense energy resilience projects, and how can we quantify these co-benefits? In cases where military energy resilience projects have been approved by commissions, there have been shared and/or additional benefits that accrue to ratepayers, ranging from enhancing the reliability of the grid to serving as a hedge against future carbon compliance costs.

- *Economic development.* DoD spending comprises a substantial share of many state economies. To the extent that regulators can consider economic impacts in their decision making, should the economic impact of supporting in-state military installations be taken into account?
- *Value of resilience.* How, if at all, should regulators integrate either local, regional, state, or national values of resilience into their decision making related to defense energy resilience investments?
- *Equity and disadvantaged communities.* Many DoD installations are located within or nearby low-income, energy-burdened communities. Are there opportunities to simultaneously create ratepayer and national security benefits through investments in disadvantaged defense communities?
- *DoD engagement.* How can regulators most effectively engage with defense stakeholders, when DoD is constrained in terms of the staff and expertise available to participate in regulatory proceedings?
- *Secure communications.* How can regulators investigate and consider defense energy resilience investments while preserving the security of sensitive national security information?
- *Cybersecurity.* Can cybersecurity investments create clearer mutual benefit for utility ratepayers and defense energy resilience than investments in physical infrastructure? How can regulators best keep up with utility industry cybersecurity requirements, DoD cybersecurity requirements for utilities that serve DoD bases, and DoD cybersecurity requirements for cybersecurity within military bases?

Regulators seeking to proactively engage on defense energy resilience can explore a number of potential steps, even as the practice and processes of collaboration continue to be developed and defined. Steps that regulators can take include:

- Identify the military installations in-state and review the extent to which DoD bases are served by regulated utilities.
- Engage the installation commanders of in-state military installations to identify planned or ongoing energy resilience projects that may rise to the level of commission consideration.
- Open proceedings to investigate, for example, the current status of utility and military partnership within the state, the nature and duration of outages experienced by military facilities, opportunities to integrate projects with military co-benefits into integrated planning, or options for low-cost or no-cost resilience improvements.
- Convene working sessions with utilities and the military to develop a shared understanding and lexicon for how current military and utility projects could be better coordinated to maximize the benefits to both parties. Explore how military requirements might translate into utility infrastructure improvements in future investment plans.
- Identify low-income, energy-burdened communities in need of resilience services that are co-located with military installations.
- Conduct new research to quantify the value of energy resilience related to defense energy investments. Work with utilities to explore whether these values could be included in the benefit-cost analyses used to evaluate proposed investments.
- Anchor investigations into the costs and benefits of utility cybersecurity countermeasures in partnerships with in-state DoD stakeholders.
- Engage in planned or ongoing defense-relevant energy projects, such as those funded through the DoD Military Installation Resilience program.
- Explore secure communications frameworks that would allow for effective decision making in a way that protects sensitive information.

Introduction

The energy manager at U.S. Army Garrison Detroit Arsenal (DTA) picked up the phone on January 30, 2019, and received a disturbing request: the local utility asked the base to immediately curtail its natural gas and electricity usage. A polar vortex had brought extreme cold temperatures to the area, which caused an unprecedented surge in demand for natural gas for heating. At the same time, a fire had broken out in the Ray Township Natural Gas Compressor Station—the largest natural gas storage site in the state (Michigan Public Services Commission [MPSC], 2017). Natural gas is used for both heating and electricity generation in Michigan, and the sudden natural gas shortages threatened to compromise the electricity system as well. DTA, nearby Selfridge Air National Guard Base, and many of the region's largest defense and automobile manufacturers voluntarily curtailed energy use, while state officials urged residents not to raise their thermostats above 65 degrees.

The efforts of the utility and its customers to reduce demand and increase gas supply helped the region to avoid widespread power outages. The polar vortex event, however, shined a light on military installations' dependence on the commercial energy system, and on the vulnerability of that system to electricity and fuel supply interruptions. Following the energy emergency, the governor directed Michigan regulators to assess the adequacy of electric, natural gas, and propane systems across the state (MPSC, 2019). In parallel, DTA, Selfridge Air National Guard Base, and its regional partners launched their own effort to identify and mitigate regional energy vulnerabilities (see Section 5.3).

The U.S. Department of Defense (DoD) is heavily dependent on the commercial electricity grid, which introduces a certain degree of risk to DoD operations. At the same time, DoD's globally networked force is increasingly reliant on secure, reliable communications from domestic installations.[1] As a result, power outages at U.S. bases can significantly impact critical missions around the world. These risks are by no means hypothetical; as recently as 2020, DoD reported hundreds of outages at its installations that lasted longer than 8 hours in duration (ASD(S), 2020c).

In 2015, Congress passed legislation focused on securing defense critical electric infrastructure (DCEI)—that is, the electricity assets that serve critical DoD facilities. The focus on DCEI is part of broader efforts by federal, state, and utility actors to support defense energy resilience by aligning civilian infrastructure investment with national security priorities. As the focus on defense energy resilience expands, it will have increasingly important implications for electricity grid planning and investment. Utilities and defense stakeholders will need to engage each other in new conversations about energy resilience and mission assurance, and state utility regulators will need to understand the opportunities and boundaries of these conversations, as well as what is at stake. There is not yet a standard or replicable set of practices for assessing, prioritizing, and funding defense energy resilience—and it is unclear how states, utilities, and defense stakeholders can best communicate and coordinate around these issues.

Utility investments in defense energy resilience raise new and complex issues for state commissions to consider. Regulators may need to convene and navigate conversations related to topics such as whether utility ratepayers should pay for defense-related upgrades, how ratepayers and defense installations can jointly benefit from resilience investments, whether commissions have sufficiently broad authority to approve defense-related resilience, and how commissions can appropriately manage sensitive information. This report provides a primer specifically for state utility regulators related to civilian electric infrastructure that serves facilities deemed critical to the defense of the United States. Each section begins with an "objective" statement that summarizes the relevance of its content for regulators. The report focuses primarily on the DoD, although the

1 A military installation is defined in 10 U.S.C. § 2801 as "a base, camp, post, station, yard, center, or other activity under the jurisdiction of the secretary of a military department." Throughout this report, the term "installation" refers to a military installation, rather than an installed energy generation facility.

findings could be extended to other defense-critical facilities at the federal and state levels as well. This report is structured as follows:

- Section 1 provides an overview of DoD's reliance on civilian power grids, and a description of the evolving threat environment.
- Section 2 explores the definition of defense energy resilience, including the origins of DCEI, and how DCEI compares to other types of defense critical infrastructure (DCI).
- Section 3 provides a primer on DoD's energy usage and organization, relationships with regulators and utilities, and energy policies.
- Section 4 summarizes ongoing initiatives that are relevant to defense energy resilience, led by utilities as well as federal and state governments.
- Section 5 offers case studies of partnerships between DoD and utilities to explore energy resilience investments that benefit DoD installations and state ratepayers.
- Section 6 explores emerging issues for regulators related to defense energy resilience, such as who should bear the financial burden of defense-related improvements and how to establish secure standards of communication for sensitive information.
- Section 7 suggests areas for future action on the part of regulators related to defense energy resilience.

1. DoD Reliance on Civilian Power Grids

Section Objectives:

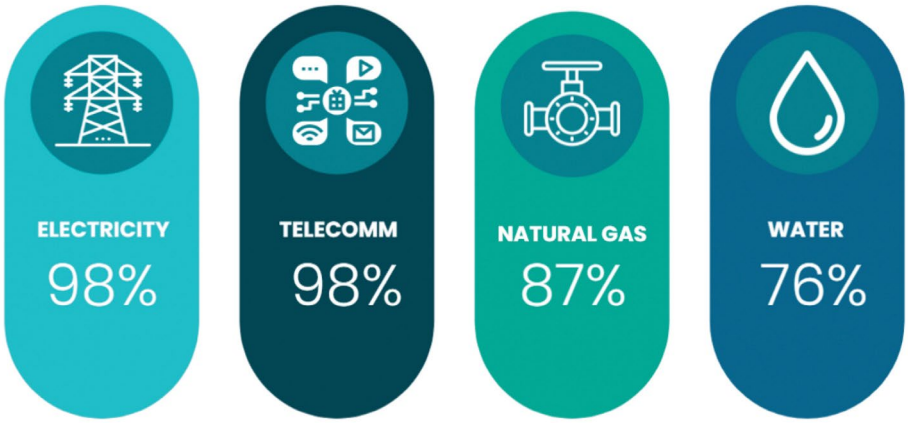
- Summarize DoD's reliance on the electricity systems regulated by state commissions.
- Review DoD's vulnerabilities within the context of the evolving threat environment.

> *DoD relies primarily on commercial power to conduct missions from its installations. Commercial power supplies can be threatened by a variety of events ranging from natural hazards and physical attacks on infrastructure to cyber attacks on its networks and supervisory control and data acquisition (SCADA) systems. The Department recognizes such events could result in power outages affecting critical DoD missions involving power projection, defense of the homeland, or operations conducted at installations in the U.S. directly supporting warfighting missions overseas.* (ASD(S), 2020a, p. 13)

Global digitalization has enabled DoD missions to increasingly operate from installations within the continental United States (CONUS). Missions such as intelligence, surveillance, and reconnaissance; cyber protection; remotely piloted aircrafts; and command and control, are completed from permanent CONUS installations. In addition to serving as command posts for missions across the globe, military installations also house the domestic emergency management functions of the National Guard, and provide family services, housing, and administrative support to the larger DoD enterprise (Kidd, 2017). As the requirements and reach of their operations expand, domestic installations increasingly need to pay attention to utility interdependencies "beyond the fence line."

Prior to and during World War II, many military installations owned and maintained their own on-base power plants, given the impracticality of connecting to the commercial grid from their remote locations. But as the civilian power grid expanded, connecting to the commercial grid became more realistic. The 1990s brought a push to privatize military power systems (U.S. DoD Deputy Secretary of Defense, 1998). Today, more than 98% of military installations depend on the civilian power grid, and DoD also relies heavily on interdependent civilian utilities for communications, natural gas, and water (***Figure 1***; Narayanan et al., 2020).

Figure 1: Percentage of DoD Installation Reliance on Community Infrastructure



Source: Adapted from U.S. Government Accountability Office [GAO] (2020a)

In fiscal year 2019 (FY19), DoD experienced 2,572 unplanned utility outages, of which 542 lasted 8 hours or longer, including at installations with missions that cannot tolerate interruptions (ASD(S), 2020a). Long-duration outages on installations with critical missions can cause a variety of severe impacts, the consequences of which extend into the public and private sectors. The next sections provide illustrative examples of the evolving threat environment and focus on the impact of extreme weather, cyber attacks, and interdependent infrastructure on DoD installations. This threat environment has spurred the development of defense energy resilience policy and frames the current DoD approach to such infrastructure investments.

1.1. Threat Environment

DoD installations provide a unique lens through which to understand the alignment between national security threats and threats to critical infrastructure. Natural and human-made hazards impacting critical infrastructure are evolving at a rapid pace, resulting in a substantial increase in risk to government and private sector entities and assets. Accurately assessing these hazards requires a clear identification of the ways in which they impact electricity systems at all levels. This section briefly reviews three categories of hazards that are shaping the defense energy resilience discussion as a result of recent events: extreme weather, cybersecurity, and system interdependencies. National Association of Regulatory Utility Commissioners (NARUC) is also focusing on these and other "black sky hazards"—such as coordinated physical attacks, electromagnetic pulse weapons, and earthquakes—through its ongoing Emergency Preparedness, Recovery and Resilience Task Force (NARUC, 2020; Stockton, 2014).

1.1.1. Extreme Weather and Disasters

Recent climate-driven events demonstrate both the accelerating pace and increasing severity of extreme weather and its impacts on critical infrastructure systems that were designed using historical data to forecast operating conditions. More than half of DoD's installations have been negatively impacted by extreme weather (USD(AT&L), 2018), and DoD has identified installations within the United States and worldwide that are vulnerable to the changing climate (ASD(EI&E), 2021; USD(A&S), 2019). No geographic region is immune to the impacts of these events. The following examples highlight how different vulnerabilities in system structure or operations may impact DoD.

Hurricanes Irma and Maria, arriving in rapid succession during the 2017 season, profoundly impacted energy, water, communications, and transportation infrastructure throughout the Caribbean region, including in Puerto Rico, the U.S. Virgin Islands, and Florida. Electricity grids suffered catastrophic damage, resulting in outages lasting up to 6 months in the U.S. territories and exposing essential systems (e.g., water treatment systems, port operations, and wireless networks) to cascading power outages. Irma and Maria were followed by Hurricane Michael in 2018, which caused over $25 billion of damage (National Centers for Environmental Information, 2020; Wamsley, 2019). Each of these events severely impacted nearby DoD installations and operations. Most notably, Tyndall Air Force Base was almost completely destroyed by Hurricane Michael due to a combination of wind damage and severe flooding.

In 2012, Superstorm Sandy, while smaller in severity than Irma and Maria, exposed the challenges associated with population impacts on a larger scale. The coordination of effort and resources needed to repair damaged electric grid infrastructure exceeded regional capacity and necessitated a national scale response, which included allocating substantial DoD assets for transportation and logistical support (Burke and McNeil, 2015). DoD's participation in Hurricane Sandy response included both National Guard units, as well as active-duty units under DoD's Defense Support for Civil Authorities authority (Yurack, 2013). Power outages at the installations that house disaster response units can degrade or delay their ability to respond to emergency events.

The unprecedented wildfire seasons in California during the summers of 2018 and 2019 exposed multiple vulnerabilities in transmission design and operation, requiring public safety power shutoffs during periods of increased fire risk. The resulting power blackouts aimed to reduce customer load in constrained areas, as well as the risk of additional grid-induced fires from asset failures. The allocation of these planned blackouts, which could not always be executed with preference to high-priority customer loads, raised questions of how energy assurance for DoD installations could be compromised by infrastructure availability.

Cold weather events in areas of the country with significant energy system constraints such as New England highlight the vulnerability to the grid of "common mode failures," which result from single points of failure in shared fuel infrastructure. Highlighted in the Operational Fuel Security Analysis report published by ISO New England in 2018, "The regional dependency on several key facilities is a particular concern highlighted by this

study. An extended outage at any one of these key facilities—a natural gas pipeline compressor station, the Distrigas LNG import facility in Massachusetts and the Mystic 8 and 9 generators it fuels, the Canaport LNG import facility in Canada, or the Millstone nuclear power plant—would result in frequent energy shortages that would require frequent and long periods of rolling blackouts" (ISO New England, 2018). This dependence poses substantial risks to the 16 DoD installations located in New England states.

1.1.2. Cyber and Determined Adversaries

The frequency, sophistication, and severity of cyber attacks continues to escalate, and the energy sector is now the target of 16% of cyber attacks worldwide as of 2019 (Ferris and van Renssen, 2021). The U.S. Department of Homeland Security (DHS) reported the issuance of 223 "security vulnerability advisories" in 2018 for industrial control systems that support power grid operations, indicating a potential risk to software systems essential to utilities. This figure represented more than a 20-fold increase in vulnerabilities of that type since 2010 when only 10 were identified and reported by DHS (GAO, 2019). Although no incidents were identified that targeted energy companies specifically to compromise service delivery to a DoD installation, the dependence of the military on private infrastructure blurs the line between government and private sector assets and creates conditions where a determined adversary could accomplish a military objective by targeting a private utility. The ransomware attacks of 2021, which included attacks on critical infrastructure assets such as the interstate fuel system operated by Colonial Pipeline, have highlighted the ways in which the targeting of private information technology (IT) and operations technology (OT) can have cascading impacts on society and economy.

Sophisticated, state-sponsored cyber adversaries, known as advanced persistent threats, possess the resources to conduct protracted and damaging attacks on OT systems, and have demonstrated those capabilities in events such as the 2015 attack on the Ukrainian grid, which resulted in power disruptions to 225,000 customers for up to 6 hours (Cybersecurity and Infrastructure Security Agency [CISA], 2016). This risk was highlighted in the Annual Threat Assessment of the Office of the Director of National Intelligence (DNI), which indicated that, "Russia continues to target critical infrastructure, including underwater cables and industrial control systems, in the United States and in allied and partner countries, as compromising such infrastructure improves—and in some cases can demonstrate—its ability to damage infrastructure during a crisis" (U.S. DNI, 2021). The report also indicated that China has the ability to engage in cyber attacks "that, at a minimum, can cause localized, temporary disruptions to critical infrastructure within the United States" (U.S. DNI, 2021). Finally, the proliferation of inexpensive and easy-to-use malware, as demonstrated in the multiple ransomware attacks of 2021, has highlighted the need for DoD and the energy sector to collaborate in developing an integrated cyber defense strategy that will protect critical assets, ensure continuity of operations, and recover quickly from events.

1.1.3. System Interdependencies

Interdependencies among critical infrastructure systems are central to discussions of risk and vulnerability. As privatization and digitalization of energy assets have increased, so has the degree of interdependence affecting critical infrastructure systems and DoD (Stockton and Paczkowski, 2019). By understanding critical infrastructure interdependencies and the ways in which they are deepening, regulators can better define the roles and responsibilities involved in reducing the risk of cascading system failures. The 2021 Texas Winter Storm Uri highlighted two key failures exposed by interdependencies: the widespread failure of gas pipelines driving outages of electricity generators and the extended loss of electric service to water treatment and pumping facilities. While those failures had little or no direct impact on transmission and distribution infrastructure, the resulting power outages ranged from hours to days in duration on DoD installations, with multiple sites losing water service for more than a week. In general, such interdependence among critical infrastructure systems can have profound consequences to operational readiness and mission assurance within the military, which in turn poses a risk to national security.

2. Defense Energy Resilience Background

Section Objectives:

- Define key terms related to defense energy resilience that regulators may encounter during engagements with defense stakeholders or during proceedings.
- Familiarize regulators with the distinctions between terms such as DCEI ("defense critical electric infrastructure") as defined by Congress, and DCI ("defense critical infrastructure") as defined through homeland security doctrine.

Defense energy resilience, as used in this report, refers broadly to improvements in the civilian infrastructure that serves facilities deemed critical to the defense of the United States. This report focuses primarily on infrastructure improvements that occur outside of DoD installations and would therefore likely be the purview of state regulators. As discussed in Section 4, however, there are also examples of on-base investments that regulators have been asked to consider that provide useful insights into how commissions make decisions. The term "defense energy resilience" includes DCEI, as defined by Congress in the Fixing America's Surface Transportation (FAST) Act of 2015. For the purposes of this paper, however, DCEI is only used as a term to refer to the specific statutory requirements set out in the FAST Act. This section provides background on the FAST Act requirements and discusses the relationship between DCEI and DCI, as defined by DoD as part of its homeland security responsibilities.

2.1. The FAST Act of 2015 and DCEI

The FAST Act was signed into law by President Obama in 2015 (H.R.22, 2015). Congress defined DCEI in the FAST Act for the first time and created a series of new authorities and responsibilities for the U.S. Department of Energy (DOE) related to grid security and critical facilities (H.R.22, 2015).

The FAST Act added section 215A, entitled Critical Electric Infrastructure Security, to the Federal Power Act. The Federal Power Act regulates interstate transmission and sales of electricity and natural gas, including interstate transportation and wholesale sale of electricity. The FAST Act amendment to the Federal Power Act included several key definitions:

- ***Grid security emergency.*** A grid security emergency is the occurrence—or danger—of physical, cyber, or electromagnetic pulse attacks, or geomagnetic storms, that would have "significant adverse effects" on the networks serving critical facilities.
- ***Critical Defense Facility (CDF).*** CDFs are facilities that are "critical to the defense of the United States" and "vulnerable to a disruption of the supply of electric energy." CDFs may include civilian nuclear facilities as well as military facilities.
- ***Critical electric infrastructure.*** Critical electric infrastructure includes bulk-power system assets and systems that if disrupted would negatively affect national security, economic security, or public health and safety.
- ***Defense critical electric infrastructure (DCEI).*** DCEI is "any electric infrastructure that serves" a CDF, "but is not owned or operated by the owner or operator of such a facility." DCEI is defined in the FAST Act to only include facilities located in CONUS, and not facilities in Alaska, Hawaii, or in U.S. territories. This report focuses on the entirety of the United States, rather than just on CONUS.

The FAST Act also included several new authorities:

- *Grid Security Emergency Order.* The Secretary of Energy can issue Orders to protect or restore critical electric infrastructure or DCEI during a grid security emergency when the President declares a grid security emergency.[2]
- *Critical Electric Infrastructure Information (CEII).* DOE and the Federal Energy Regulatory Authority can designate information as CEII, which is used to protect and secure information about the nation's electric infrastructure. CEII is discussed in greater detail in Section 6.4.
- *CDF designation.* DOE can designate CDFs in consultation with DoD. As of June 2021, DOE and DoD had completed the CDF designation. The list of CDFs is controlled unclassified information (CUI) and categorized as CEII.

DOE has identified several lines of effort to strengthen DCEI and CDFs, including providing targeted technical assistance to defense communities to demonstrate DCEI solutions, supporting the development of metrics that reflect the consequence of grid disruptions, and analyzing critical infrastructure dependencies in partnership with CDF owners (DeCesaro and Zetterberg, 2020). More detail on DOE's defense energy resilience-related activities can be found in Section 4.2.

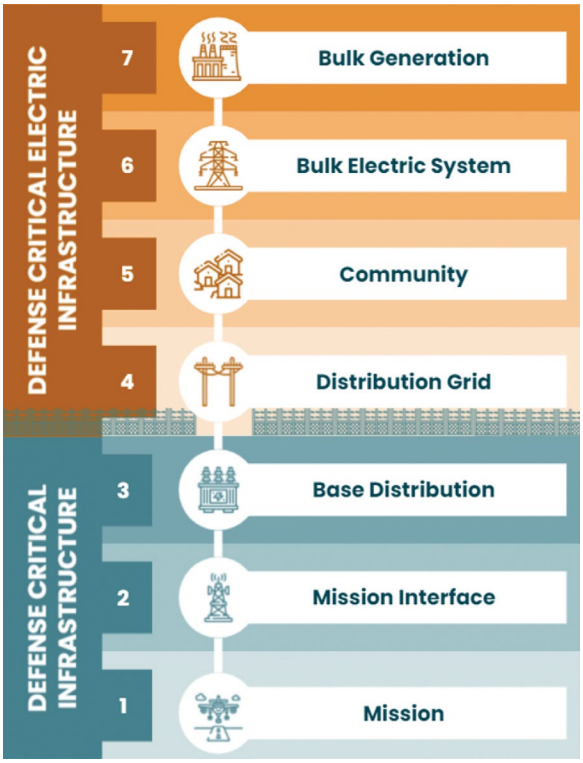
2.2. Critical Infrastructure Inside and Beyond the Fence Line

Congress and the federal government have established a range of different frameworks and methods for defining critical infrastructure, and this report does not attempt to summarize or compare them. For the purposes of defense energy resilience, regulators should be aware of the distinctions between DCEI, DCI, and Section 9 organizations (see *Text Box 1*).

Whereas Congress defined "DCEI" as the systems—for example, the power plants and "poles and wires"—that serve critical defense installations, DoD defines "DCI" as the "assets and facilities essential to project, support, and sustain military forces and operations worldwide" (OSD, 2021b). DCI is identified by DoD as part of its responsibilities outlined in Presidential Directives related to homeland security (ASD(HD&GS), 2021). DCI is not limited solely to energy infrastructure, although energy is included within DCI. Appendix A provides additional detail about the policies that defined DCI and led to the creation of the DoD Defense Critical Infrastructure Program. *Figure 2* summarizes the relationship between DCEI and DCI for the purposes of this paper.

In terms of energy systems, DCEI includes infrastructure from the bulk-power system down to the distribution systems that serve the base. DCI-relevant electricity systems include the distribution system within the installations, the systems that support missions' connections to other locations, and the on-base energy systems that provide resilience to the missions themselves.

Figure 2: Delineation of DCEI and DCI



The delineation between DCEI and DCI can be thought of as whether the asset in question is "beyond the fence line"—that is, outside the DoD installation (and outside of DoD control)—or inside the fence line.

2 The procedures for issuing a Grid Security Emergency Order can be found in 10 CFR Part 205.

Detailed information related to DCI and DCEI assets is typically confidential or classified. Therefore, many of the cases used in this report to explore defense energy resilience investments are drawn from important, if noncritical, examples.

Text Box 1: Section 9 Critical Infrastructure

Federal government engagement on critical infrastructure is led by the DHS and divided into 16 sectors, including energy. Presidential Executive Order No. 13636, Improving Critical Infrastructure Cybersecurity, Section 9(a) utilizes a risk-based approach to identify entities defined as "critical infrastructure where a cybersecurity incident could reasonably result in catastrophic regional or national effects on public health or safety, economic security, or national security" (CISA, 2018). While beyond the fence line infrastructure encompasses a comparatively wide range of potential assets and organizations, Section 9 provides a more specific identification of companies who provide direct services to facilities and assets relevant to homeland security and national defense.

To date, the Section 9 program has functioned as a conduit of information exchanges between DOE, DHS, DoD, and the energy sector for the purpose of disseminating threat information, providing classified briefings, and discussing sensitive topics related to shared security issues. The program has not been used for the development of frameworks for joint infrastructure or resource planning, shared risk assessment, or implementation of programs supporting DCEI. However, the existing stakeholder structure and sensitive information sharing protocols are conducive to supporting key elements of the DCEI program.

3. DoD Energy Resilience Background

Section Objectives:

- Summarize DoD institutional responsibilities related to energy resilience.
- Provide context for the modes in which DoD representatives may interact with regulators.
- Review the different contractual and commercial relationships that regulated utilities may have with DoD installations.
- Summarize DoD energy policy as it relates to energy resilience, energy supply, and energy efficiency.

When attempting to engage DoD on issues related to energy resilience, it is important to understand the sheer size and scale of its energy demand, the structure in which DoD operates, and the energy policy that guides DoD's actions. This section provides regulators with a short introduction on DoD as an energy consumer and as an energy project advocate, to shed light on the different interactions that regulators may have with DoD and provide a better understanding of DoD's objectives in its interaction with regulated utilities.

3.1. DoD Energy Background and Organization

DoD is the world's largest consumer of energy, with an annual energy budget of up to $20 billion (Greenley, 2019). Within DoD, energy is divided into two types: operational energy and installation energy. Operational energy consists of "the energy required for training, moving, and sustaining military forces and weapons platforms for military operations and training" (ASD(S), 2020a). Operational energy comprises the largest share of DoD's energy budget; in FY21, DoD's fuel expenditure is estimated to exceed $10.2 billion (ASD(S), 2020c). Installation energy refers to the electricity and fuel that powers the buildings and nontactical vehicles on DoD domestic bases.

DoD's installation energy footprint is also significant, spanning several hundred large sites and over 3,000 smaller sites across all 50 states, five U.S. territories, and the District of Columbia (ASD(I), 2018). These sites include over 200,000 buildings and encompass more than 26 million acres—roughly equivalent to the land area of the state of Tennessee.

The Office of the Secretary of Defense (OSD) is responsible for establishing installation energy policy. OSD establishes policies and delegates authorities through DoD Directives (DoDD) and assigns responsibilities and outlines procedures for implementing policies through DoD Instructions (DoDI; DoD Chief Management Officer, 2016). The military services (e.g., Air Force, Army, Navy) are ultimately responsible for carrying out OSD policy and effectively managing their installations' energy. Within the services, there are multiple levels of energy governance and responsibility, including:

- **Assistant secretaries for installation energy:** Each department appoints an assistant secretary to serve as a senior executive for installation energy at the DoD headquarters level.
- **Energy program offices:** The services each have dedicated energy program offices that serve as a conduit between individual installations, DoD headquarters, and the private sector. The Air Force's Office of Energy Assurance (OEA), the Army's Office of Energy Initiatives (OEI), and the Navy's Energy Security Program Office[3] each coordinate project development at their installations and support the development and execution of Installation Energy Plans (IEPs).[4]

3 The Energy Security Program Office was previously known as the Resilient Energy Program Office, and before that as the Renewable Energy Program Office (Kleim, 2016, 2017, 2019)

4 An IEP is a "holistic roadmap that enables the installation to work constructively towards its goals in energy efficiency, renewable energy and energy resilience" (ASD(S), 2016)

- **Installation leadership and staff:** At an individual military installation, energy resilience is the responsibility of installation leadership (e.g., Garrison or Wing Commander), installation energy leadership (e.g., public works director or base civil engineer), and any distinct mission owners or other tenants located on the military installation that have separate chains of command.

When regulators are engaging with DoD, they should be mindful of the level of DoD bureaucracy with which they are interacting. Successful collaboration with DoD may require consultation and alignment at each of these levels. It is also important to distinguish between DoD's engagement with regulators outside of regulatory proceedings and during regulatory proceedings. Army OEI, for example, is a NARUC member and has actively participated in NARUC meetings and events (McGhee, 2019). OEI and the other energy program offices have informal conversations with regulators during the course of their energy project development efforts. They may also provide expert testimony in regulatory proceedings related to military energy projects. As described in the next section, however, the energy program offices do not lead formal regulatory intervention on behalf of DoD or on behalf of the federal government.

3.2. DoD Regulatory Intervention

DoD commonly engages with regulators during cases that would impact federal electricity rates.[5] The federal government has established protocols for intervening in utility rate and rulemaking proceedings, and the U.S. General Services Administration (GSA) has the principal responsibility for representing the government's interests (Sepulveda and Smith, 2017). GSA may delegate responsibility for representing the government to other federal agencies (Federal Acquisition Regulation, 2019). At present, GSA has delegated responsibility in specific regulatory jurisdictions and cases to the Air Force, Army, Navy, DOE, and Department of Veterans Affairs (Sepulveda and Smith, 2017).

GSA coordinates these agencies' efforts through the Federal Rate Intervention Working Group (FRIWG). If the decision is made to intervene in a rate case or a rulemaking proceeding, "the Federal executive agency constituting the largest energy user affected … typically takes the lead on any intervention" (U.S. Department of the Air Force, 2016). If the Air Force has the largest exposure to a rate increase in a specific utility service territory, for example, then the Air Force would intervene and represent all federal agencies. The specific DoD offices with responsibility for rate intervention include:

- Air Force Judge Advocate General Operations, International Law Directorate, Environmental Law and Litigation Division (U.S. Department of the Air Force, 2016),
- Army Legal Services Agency, Regulatory Law and Intellectual Property Office (U.S. Department of the Army, 2015), and
- Navy Naval Facilities Engineering Command (NAVFAC) Utility Rates and Studies Office.

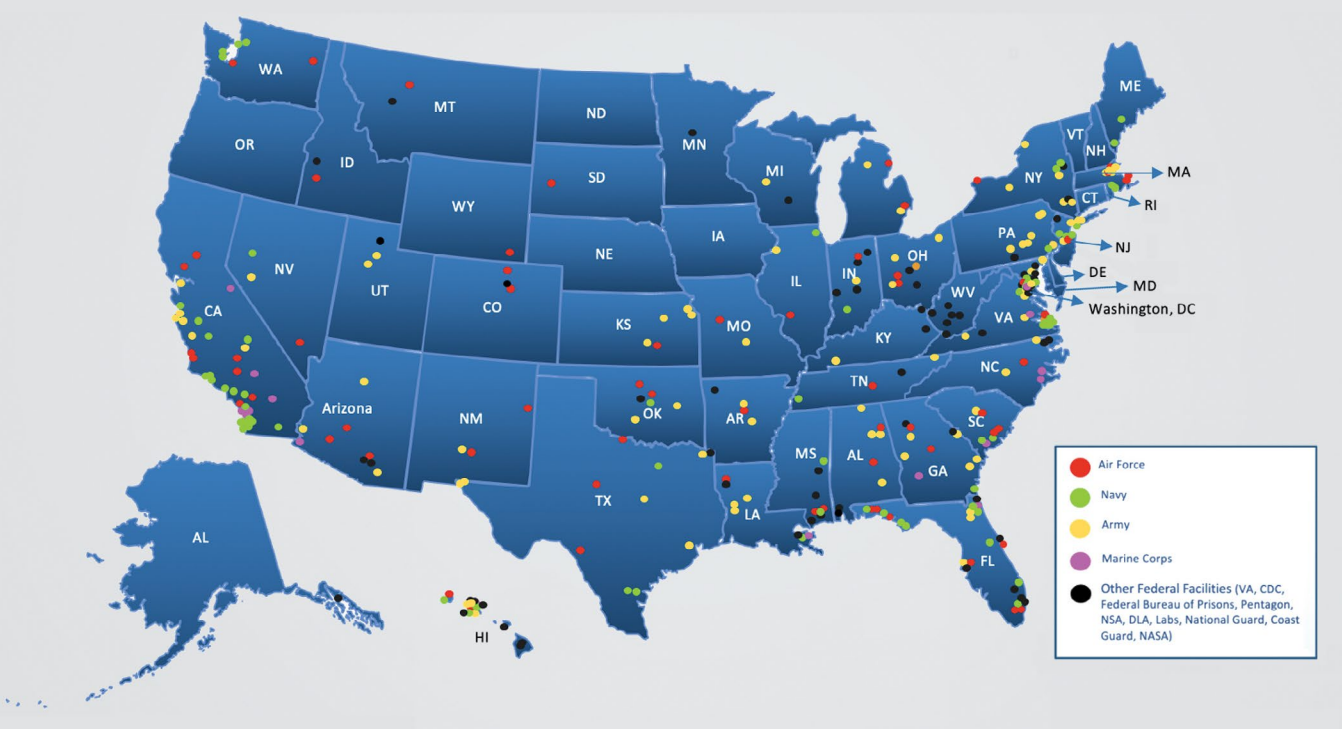
GSA's authority and statutory responsibility to represent the consumer interest of the federal executive agencies is not limited to rate cases alone. GSA, in coordination with FRIWG, represents the interests of taxpayers not only in cases of cost allocation, but also to advocate for positions that align with federal policy.

3.3. DoD and Utilities

DoD is served by hundreds of different utilities, of all types, and across different electricity market structures. This report focuses on utilities regulated by state commissions. In most states, only investor-owned utilities (IOUs) are regulated by the commissions. Across the country, IOUs serve over 300 major military and national security installations (***Figure 3***).

5 See, e.g., Public Utility Commission of Texas (2019) and Florida Public Service Commission (2018)

Figure 3: DoD and Federal Installations Served by IOUs



Source: Edison Electric Institute [EEI] (2019)

More than 100 rural electric cooperatives serve DoD facilities across 39 states (Cooperative.com, n.d.), but cooperatives are regulated by state commissions in 16 states (Appendix B). Municipal utilities also serve military installations (Partain, 2020), but municipal utilities are not fully regulated by commissions in any state.

Although this report focuses primarily on electric utilities, DoD's vulnerability to interdependent system failures (Section 1.1) and its emerging support for regional planning (Section 4.3), may create opportunities for cross-sectoral engagement between DoD and regulators. However, state commissions vary in terms of which utility industries they regulate. Of the 55 regulatory commissions that span the 50 states and Puerto Rico, NARUC research has found that 96% have authority over electricity and natural gas, 89% regulate communications, 82% regulate water and wastewater, and 44% regulate transportation.

As discussed in the introduction to this report, ratepayer investments in defense energy resilience improvements outside the fence line will require new modes of communication and coordination that have not yet been established. DoD installations do have existing relationships with regulated utilities that can take on a variety of forms. Some of these relationships are within the purview of state regulators, and some of which are governed instead by federal regulations and contracting officers. Examples of DoD relationships with regulated utilities include:

- *DoD as a ratepayer.* As discussed in Section 1, almost all DoD installations depend on the commercial grid for electricity. DoD's relationship with utilities is subject to regulation in the same manner as that of other electricity ratepayers.
- *Utilities privatization.* DoD built, owns, operates, and maintains the electricity systems that distribute electricity within many of its installations. As discussed in Section 1, however, DoD has worked to privatize its electric, water, wastewater, and natural gas utilities over the past several decades. Using its utilities privatization (UP) authority, DoD can convey the ownership and operations of its utility systems to third parties. As of December 2019, approximately 52% of DoD's utility systems were privatized, or were built and owned by an entity other than DoD (GAO, 2020b). Different entities serve as UP providers, including,

for example, companies dedicated only to UP contracting and utility companies that serve wider service territories (Utility Privatization Partners, n.d.). More than 30 electric cooperatives have assumed ownership of military installation electricity infrastructure through UP contracts (National Rural Electric Cooperative Association, 2020). Even in cases where regulated utility companies have taken ownership of distribution systems on DoD installations, state commissions do not have jurisdiction over the relationship between DoD and the UP system owners.

- *Areawide contracts.* Whether the on-base electricity infrastructure is owned by DoD or by third parties, DoD facilities can opt to purchase commodity energy and energy services through the GSA Areawide Contracts. The areawide contracts are 10-year master blanket contracts between GSA and utility service providers (GSA, n.d.). The contract terms and conditions contain all applicable federal clauses, and any federal facility within the utility service territory served by the areawide can use it to purchase energy. Only utilities regulated by the state commission are eligible to enter into areawide contracts with GSA. GSA notes that "Although the state [commission] provides some oversight through its established program of regulatory review, federal contracting officers are ultimately responsible for ensuring that price and technical proposals meet all necessary standards and requirements, including subcontracting plan requirements" (GSA, n.d.).
- *Utility energy services contracts (UESCs).* UESCs are a federal acquisition authority that allows DoD facilities to enter into energy performance contracts with the utilities that serve them.[6] In many parts of the country, DoD can enter into UESCs through its existing GSA Areawide Contracts. UESCs can be up to 25 years in length and can be used to finance energy savings and conservation upgrades based on the savings that the upgrades are projected to generate over time. The federal government actively promotes UESCs (DOE/EERE, n.d.), and regulated utilities have invested more than $3 billion through over 2,000 UESCs since the 1990s (EEI, n.d.). DoD has issued policies stipulating that UESCs should be used to maximize energy resilience (ASD(S), 2018), and military facilities have used UESCs for inside the fence line substation and distribution system upgrades (DOE/EERE, 2021). State commissions do not regulate assets acquired under UESCs.
- *DoD facilities as energy project sites.* DoD energy policy encourages DoD facilities to partner with third-party capital providers and developers to implement power generation on base using a range of different acquisition authorities (Rickerson et al., 2020). These include power purchase agreements (PPAs) wherein the DoD serves as the electricity offtaker (10 U.S.C. § 2922a, 2018), easements for electricity infrastructure on DoD land (10 U.S.C. § 2668, 2018), and enhanced use leases (EULs), by which DoD allows power plants to be built on its property in exchange for an upfront payment or an in-kind contribution of equivalent value (10 U.S.C. § 2667, 2018). State commissions may be required to consider and approve projects under which DoD proposes to host utility-owned projects that feed electricity into the grid. A case study of one of these projects is included in Section 5.

In addition to understanding DoD's relationships with regulated utilities, it is also useful for regulators to have insight into DoD's energy policy requirements. The next section provides a brief primer on the energy policies, strategies, and programs that DoD has put in place to help meet its objectives and requirements.

3.4. DoD Energy Policy

DoD energy policy is shaped not only by doctrine from the Secretary of Defense, but also by Presidential executive orders and by Congress. DoD's energy policy focuses on maximizing efficient energy use, expanding supply for mission assurance, and enhancing energy resilience (ASD(S), 2020a).

6 The FY 2007 National Defense Authorization Act (NDAA) created UESC authorities specific to DoD that are similar to, but distinct from, the authority of other federal agencies. See 10 U.S.C. 2913.

- *Maximize efficient energy use.* Since the oil embargo crisis of the 1970s, the President and Congress have mandated energy efficiency for federal agencies as a means to improve energy security. In 1977, Executive Order 12003 required federally owned buildings to reduce their energy consumption by 20% by 1985 (E.O. No. 12003, 1977). Most recently, the Energy Independence Security Act (EISA) of 2007 updated previous policy and required that DoD reduce its energy consumption by 30% from a 2003 baseline.
- *Expand supply for mission assurance.* The Energy Policy Act of 2005 requires 7.5% of the electricity consumed by all federal facilities to come from renewable energy sources starting in 2013 and each year thereafter. The National Defense Authorization Act (NDAA) of 2007 requires that DoD "procure or produce" the equivalent of 25% of the electricity it consumes from renewable energy sources by 2025 and each year thereafter. In response to this legislation, DoD has prioritized building renewable energy projects at or near their installations.
- *Enhance energy resilience.* During the last decade, energy resilience has been elevated to be a central tenet of DoD energy strategy through a series of laws and DoD policies. In 2014, DoDD 4180.01 established the need to improve energy security and "enhance the power of resiliency of installations." In 2016, DoDI 4170.11 was updated and broadened to require that DoD "take necessary steps to ensure energy resilience on military installations ... and have the capability to ensure available, reliable, and quality power to continuously accomplish DoD missions from military installations and facilities." The FY18 NDAA codified and defined energy resilience for the first time in law and made energy resilience a central focus of DoD energy policy (H.R.2810, 2017). Each of the military services have also established their own energy resilience mandates for their installations. In 2020, the Army and Navy both established requirements stipulating that installations' mission essential functions must be able to operate independently from the electric utility grid for a minimum of 14 days (U.S. Secretary of the Army, 2020; U.S. Department of Navy, 2020). The Air Force currently maintains a critical missions requirement of at least 7 days (U.S. Secretary of the Air Force, 2020).

Under the Biden Administration, energy resilience, with a particular focus on climate change, has continued to play a central role in guiding DoD energy policy. Executive Order 14008 requires the Secretary of Defense to develop an action plan to "bolster adaptation and increase resilience to the impacts of climate change" and to prepare a Climate Risk Analysis within 120 days (E.O. No. 14008, 2021). DoD has responded to these orders by planning "to complete climate exposure assessments on all major U.S. installations within 12 months and all major installations outside the CONUS within 24 months using the Defense Climate Assessment Tool" (DoD, 2021a).

The ambitious energy resilience goals established at both the headquarters and department levels of DoD has resulted in the need to rapidly expand the deployment of energy resilience solutions across DoD installations worldwide. Currently, DoD use different types of Congressionally appropriate funds to directly pay for energy resilience projects, including Military Construction, Operations and Maintenance funding, and Research, Development, Test, & Evaluation. A subset of Military Construction, the Energy Resilience and Conservation Improvement Program, is designated specifically for projects that "improve energy resilience, contribute to mission assurance, save energy, and reduce DoD's energy costs" (ASD(S), 2020b). The Energy Resilience and Conservation Improvement Program budget has been funded at $150 million annually (ASD(S), 2020d).

Although the energy resilience imperative has grown stronger over the past decade, Congressional appropriations on their own are insufficient to deliver energy resilience across DoD. As a result, DoD leverages third-party financing through a range of different acquisition authorities (Section 3.3) to implement energy resilience projects in partnership with qualified energy service companies, utilities, and other developers (Rickerson et al., 2021).

4. Ongoing Efforts Related to Defense Energy Resilience Investment

Section Objectives:

- Summarize recently launched initiatives that support defense energy resilience.
- Update regulators regarding ongoing activities and funding sources that may be relevant to current or future commission proceedings.

The emphasis on defense energy resilience outside the fence line of military installations is relatively new. Although Congress defined DCEI in 2015, for example, DOE only received appropriated funds to focus on DCEI in FY21 through the DOE Office of Electricity (OE) Budget (DOE, 2020a). The structures through which DoD, utility partners, and state and local governments collaborate remain in the early stages. There are a range of ongoing programs and activities relevant to defense energy resilience, however, that have been launched within the last 2 years. These programs and activities can both inform, and be integrated into, the emerging dialogue about the intersection between national security and utility regulation.

4.1. DoD–DOE Memorandum of Understanding

In September 2020, the DoD Office of the Assistant Secretary of Defense for Sustainment (ASD(S)) and the DOE Office of the Assistant Secretary for the OE (for Office of Electricity) signed a "Memorandum of Understanding (MOU) Concerning a Collaboration to Enhance Energy Resilience" (ASD(S) and DOE/OE, 2020). The purpose of the MOU is to "strengthen coordination efforts related to energy resilience and the protection of military installations and defense critical electric infrastructure (DCEI)." The MOU identifies several activities, including the development of joint pilot projects and programs to support energy resilience, ensuring that the DOE National Laboratories can align their activities to meet DoD national security and energy resilience requirements, and engaging utilities to "ensure the prioritization of DCEI." DoD and DOE also agreed to collaborate with utilities to "provide input on integrated resource plans (IRPs), future generation and other infrastructure siting, rates, and the prioritization of certain generation within transmission queues."

4.2. DOE Programs

DOE has the lead federal responsibility for DCEI. The DOE/OE led DCEI development during the first several years of the program (DeCesaro and Zetterberg, 2020). The DCEI program did not receive Congressional funds to operate, however, until the FY21 budget.[7] In June 2021, responsibility for DCEI transferred within DOE to the Office of Cybersecurity, Energy Security, and Emergency Response (CESER). The DOE FY22 Congressional Budget Request identified additional funding to go toward DCEI programming and "proposed to integrate the functions of the DCEI Energy Mission Assurance program into CESER's suite of activities partnering with, supporting, and sharing information with the electric utility industry to enhance energy resilience through its energy assurance planning efforts" (DOE, 2021, p. 12). In addition to core DOE DCEI programming, examples of ongoing defense energy resilience-related DOE initiatives include:

- *Energy Resilience for Mission Assurance (ERMA).* The ERMA project focuses on developing metrics and modeling capabilities to quantify how improvements in grid resilience can translate to improved performance of critical military missions during energy supply disruptions. A key objective of ERMA is to support DoD dialogue with state and utility partners, and to help utilities integrate DoD energy requirements into resource and investment planning. ERMA is funded by the DOE Grid Modernization Lab Consortium and led by a team of six national laboratories. ERMA is partnering with the National Rural Electric Cooperative Association and with Dominion Energy to conduct energy resilience analyses for military installations and utilities in Alaska, North Carolina, Virginia, and Wyoming.

7 The OE received $1.65 million to "identify, evaluate, prioritize, and assist in developing executable strategies to strengthen the energy infrastructure systems that supply critical infrastructure needed to ensure government continuity following severe natural and man-made disasters" in coordination with the owners and users of DCEI (DOE, 2021).

- *Energy Assurance for Critical Infrastructure (EACI).* Under the EACI program, national laboratory teams provide targeted technical assistance to support critical infrastructure in and around military installations. The ultimate goal of the work is to develop repeatable analytic frameworks to assess how critical infrastructure can support military mission assurance requirements. This includes, for example, feasibility studies for energy resilience solutions at military installations and resilience analyses of critical facilities that serve DoD installations. In 2019, for example, the EACI program conducted a feasibility study for a microgrid at the Port of Alaska, which is a critical supply node for Joint Base Elmendorf-Richardson and the wider Anchorage, AK, region (OEA, 2020). The port project concept was identified through a military-civilian regional utility infrastructure resilience planning process led by the U.S. Air Force.
- *Electricity Advisory Committee (EAC).* The DOE EAC advises DOE on "current and future electric grid resilience, security, reliability, sector interdependence, and policy issues of concern" (EAC, n.d.). EAC has 35 members drawn from state government, the utility industries, and the private sector. A specific focus of the EAC is to make recommendations to address the "interdependence of and risk to critical sectors such as defense, communications and transportation." In November 2020, DOE created the Grid Resilience for National Security subcommittee of the EAC (DOE/OE, 2020a), with a specific focus on strengthening the resilience of DCEI to catastrophic threats and cascading failures across interdependent utility sectors (EAC, 2020).

4.3. DoD Programs

The military services' energy program offices (see Section 3.1) work with private sector partners to develop and finance energy resilience projects on installations, but the DoD does not have formal programs dedicated to engaging with utilities on grid resilience. DoD does have several initiatives and programs, however, that may contribute to energy resilience partnerships with regulated utilities.

4.3.1. Office of Local Defense Community Cooperation

DoD engages in a wide range of partnerships with civilian entities and has multiple grant programs that can support community investments in resilience (Air Force Community Partnership Program, 2016; GAO, 2020a; Paulmann et al., 2020). The DoD Office of Local Defense Community Cooperation (OLDCC) administers several community investment programs that can be used to support energy resilience investments outside the fence line. OLDCC's original mission was to support state and local economies that had been adversely impacted by base closures, base realignments, defense industry cutbacks, or personnel reductions.[8] OLDCC's mission has expanded over the years to include issues such as land use planning to mitigate encroachment and to support defense manufacturing capabilities. The FY19 NDAA added supporting "military installation resilience" to the eligible uses for DoD community support funding.[9] In response to the FY19 NDAA, OLDCC created the Military Installation Resilience (MIR) Program in FY20. The FY19 NDAA also created the Defense Community Infrastructure Program, which is also administered by OLDCC. These two programs are discussed in the following.

Military Installation Resilience (MIR) Program

The MIR Program provides planning and technical funds to review military installation resilience, identify risks to the civilian infrastructure that supports critical DoD missions, and identify mitigation strategies for those risks.[10] State, local, and tribal governments can apply for funds to work with installations that OLDCC determines are

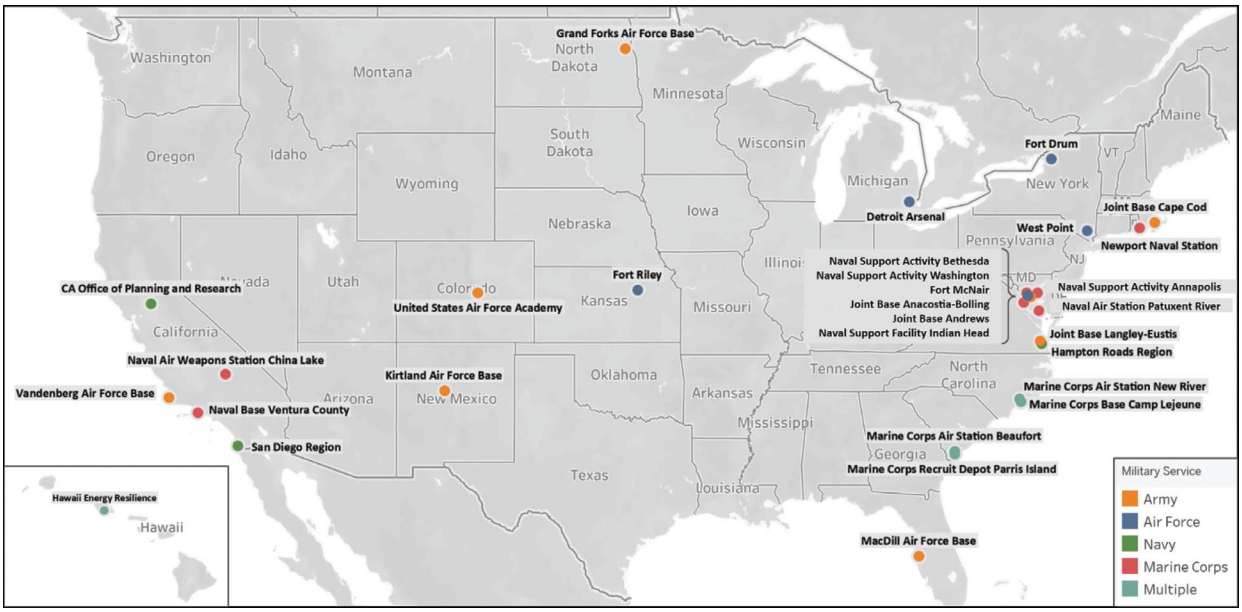
8 The Department of Defense Authorization Act of 1981 (S.815—97th Congress) created 10 U.S.C. 2391 (2018) to enable military base reuse studies and community planning assistance when military installations close. This law, in combination with Executive Orders (e.g., Bush [EO No. 12788, 1992] and Bush [EO No. 13378, 2005]) and DoD policies (e.g., DoDD 5410.12 and DoDI 3030.2) gave DoD the authority and responsibility to support communities.

9 The FY19 NDAA defined "military installation resilience" and amended 10 U.S.C. 2391 (2018) to include it under Adjustment and Diversification Assistance.

10 The full name of the funding program is *Community Economic Adjustment Assistance for Responding to Threats to the Resilience of a Military Installation.*

vulnerable to system failures outside the fence line. As of July 2021, OLDCC had awarded 28 grants totaling approximately $15 million. *Figure 4* shows the military installations that were awarded funding from FY19 to FY21 by military service.

Figure 4: Map of OLDCC MIR Grant Recipients FY19–FY21



Source: Converge Strategies, LLC research (2021), adapted from SAM.gov

OLDCC MIR funds can be applied to assess a broad range of risks to military energy resilience, and many of them on regional energy resilience. The projects convene electric, gas, water, and communications utilities, and several of them explicitly plan for regulator engagement. *Text Box 2* provides a summary of a planned project for the U.S. Military Academy that involves both on-base resilience upgrades, as well as an examination of the electric infrastructure serving the base. Section 5.3 provides a case study of another MIR project, the ongoing Detroit Arsenal Regional Defense Assessment of Resilience (DAR2) project that is being managed by Macomb County, MI, and a team of regional partners.

Text Box 2. West Point Military Installation Resilience

The U.S. Military Academy and the U.S. Army Garrisons at West Point are undertaking several concurrent initiatives to harden their energy infrastructure, increase their energy supply, and diversify their energy portfolio. These initiatives include installing on-site generation, battery storage, and a microgrid to build a "layered defense" for energy resilience on campus.

In parallel, Orange County, NY, is leading a military energy resilience study with support from OLDCC to analyze critical infrastructure and energy risks to West Point and its adjacent communities. The study focuses on assessing the vulnerability of regional energy systems to both climate and man-made hazards. The study will identify single points of failure and study the capacity of the grid to meet the needs of the installation and the surrounding area. Orange County and its partners will assess the feasibility of both on-base and off-base energy resilience projects and will consider shared solutions that could benefit both the installation and the communities. The project will develop an Energy Supply Action Plan that will identify short-term upgrades to the electric grid that would support "a reliable, redundant, and resilient power supply." The Energy Supply Action Plan will complement an ongoing process being undertaken by Orange and Rockland Utilities and West Point to upgrade the capacity of the electrical transmission lines serving the region (Orange County, 2021). The project will also develop a Microgrid Action Plan that will consider solutions for both the military installation and the surrounding towns.

Defense Community Infrastructure Program

OLDCC manages the Defense Community Infrastructure Program, which supports community resilience by providing funding "to address deficiencies in community infrastructure, supportive of a military installation, in order to enhance military value, installation resilience, and military family quality of life" (OLDCC, 2021). Defense Community Infrastructure Program was authorized in the FY19 NDAA and funded with $50 million in FY20 (Herrera, 2020). In FY21, Defense Community Infrastructure Program announced $60 million in available grant funding for projects that will be "construction-ready" within the first 12 months after award of a grant. Eligible applicants include "state or local governments and not-for-profit, member-owned utility services owning infrastructure outside of, but supporting, a military installation" (Grants.gov, 2021). There is a cost share requirement for projects proposed in areas with >100,000 inhabitants.

Eligible projects are evaluated based on four criteria: military value, proposed enhancement, construction readiness, and enhancement need. "Military value" is predetermined by the 2005 DoD report to the Base Realignment and Closure (BRAC) Commission (U.S. Department of the Army, 2005). The BRAC report scores and ranks military installations separately across the three military departments using a variety of criteria. A number of projects related to electric infrastructure upgrades were identified by communities and then proposed as part of the FY20 grant round (Association of Defense Communities, 2019). In FY20, however, only projects relating to military family quality of life were selected for funding by DoD (OLDCC, 2020). Although future rounds may award a larger share of funding to energy-related projects, these will be most relevant to commissions that regulate cooperative utilities since IOUs are not directly eligible for project awards.

4.3.2. Defense Science Board

Defense Science Board (DSB) provides advice and recommendations to the OSD (for Office of the Secretary of Defense) and to the military services on evolving threats and opportunities for technological, operational, and managerial innovation (DSB, 2021). The DSB comprises 50 industry, government, and retired military leaders and conducts research and investigations through dedicated subcommittees and task forces. In 2019, DoD created the DSB Task Force on Department of Defense Dependencies on Critical Infrastructure (USD (R&E), 2019). The task force's mission is to "investigate DoD's dependencies on non-DoD owned critical infrastructure with a focus on the energy, water, transportation, and communication sectors, and potential vulnerabilities and consequences from intentional multi-domain attacks against them" (DSB, n.d.). The task force terms of reference notes that DoD's engagement with critical infrastructure owners "for sustaining operations in a time of crisis is both limited and nascent." The task force has conducted research and engaged industry with the focus on "at least a minimum essential level of availability of key infrastructure supporting critical DoD missions in any circumstance." In February 2021, Secretary Austin suspended DSB activity as part of a broader zero-based review of more than 40 DoD advisory committees (OSD, 2021a). DSB was approved to resume operations in September 2021 (DoD, 2021c), and it is expected that the task force will release an unclassified report of its findings and recommendations in the coming months.

4.4. Utility Industry Programs

Utilities have collaborated with DoD to upgrade the energy systems of installations across the country, and there are examples of utility companies that have created specific programs to support investment in DoD energy projects across their service territories, such as Southern Company's Pentagon Partnership.[11] Coordinated efforts across the utility industry to engage in defense energy resilience, however, remain nascent. In May 2021 EEI, the industry association for U.S. IOUs, entered into a MOU with the Department of the Army to develop best practices for joint energy resilience planning. Acknowledging the Army's installation resilience efforts

11 The Pentagon Partnership was a Southern Company initiative under which they engaged military bases across the utilities within their portfolio (i.e., Alabama Power, Georgia Power, and Mississippi Power) to develop large-scale solar PV projects across the Southeast. See Rickerson et al. (2018).

"inside the fence line," the MOU focuses on facilitating "dialogue and coordinated actions to identify potential opportunities … for improving the reliability and resilience of the electric service for Army installations and their communities." EEI and the Army each committed to identify pilot locations for joint planning between military installations and utilities. EEI and the Army will produce a document identifying opportunities to improve the resilience of Army installations by the end of 2021.

4.5. State Government Programs

State governments have supported military energy resilience through a variety of different channels, although these efforts have primarily been project-specific and focused on inside the fence line activities, rather than coordinated or concerted efforts to address defense energy resilience.

4.5.1. Energy Offices

Some state energy offices have partnered directly with DoD and provided funding to military energy resilience projects. The California Energy Commission, for example, signed an MOU with the Department of the Navy to support renewable energy development, energy security, and energy reliability (California Energy Commission, 2016), following recommendations from the California Governor's Military Council (2015). California Energy Commission has provided grant funding to a range of DoD projects, such as adding battery storage to the microgrid at Marine Corps Air Station Miramar in San Diego (Rickerson, Wu and Pringle, 2018). The Massachusetts Department of Energy Resources supported a study for clean energy and microgrid opportunities at all the bases in the state (MA Department of Energy Resources and Mass Development, 2014), and the Massachusetts Clean Energy Center supported a microgrid feasibility study at Hanscom AFB (TRC, 2020).

4.5.2. Military Coordination

Over 35 states have military advisory bodies dedicated to coordinating with DoD, and 13 states have funds to enhance the military value of installations (National Conference of State Legislatures, 2016). As discussed in Section 6.2.1, the primary purpose of these offices and funds is economic development. In recognition of DoD's energy resilience objectives, some of the funds have supported military installation energy resilience. The Connecticut Office of Military Affairs, for example, provided a grant to the microgrid at SUBASE New London (CT Office of Military Affairs, 2020).

4.5.3. Utility Commissions

State regulators have had only limited involvement with DoD related to energy resilience investments. The project team conducted interviews with commissioners and staff from states with the largest concentrations of military installations and personnel, and from states in which DoD contributes a large share of annual state economic activity. Interviewees reported that DoD rarely reaches out proactively to discuss energy resilience priorities. As a result of the policies and initiatives discussed in the previous sections, however, commissions are beginning to engage with DoD around infrastructure investments that support military energy resilience. The next section presents case studies of commission engagement with issues related to DoD and DCEI.

5. Case Studies

Section Objectives:

- Highlight examples of how regulators have engaged with defense energy resilience projects.
- Provide detailed information on defense energy resilience projects, including the project type, deal structure, key stakeholder involvement, and so on.

There is an emerging body of case studies focusing on military microgrids (Klauber et al., 2021) and on community partnerships to support DoD energy resilience (Rickerson et al., 2018). This section builds on earlier work by presenting case studies of defense energy resilience initiatives that involved regulator engagement. The case studies were chosen to reflect a diversity of states with different geographies, electricity market structures, and regulatory environments. The case studies also intentionally focus on projects at different scales: generation infrastructure sited on DoD land, transmission infrastructure surrounding a DoD base, and multi-utility engagement in a region containing multiple DoD installations.

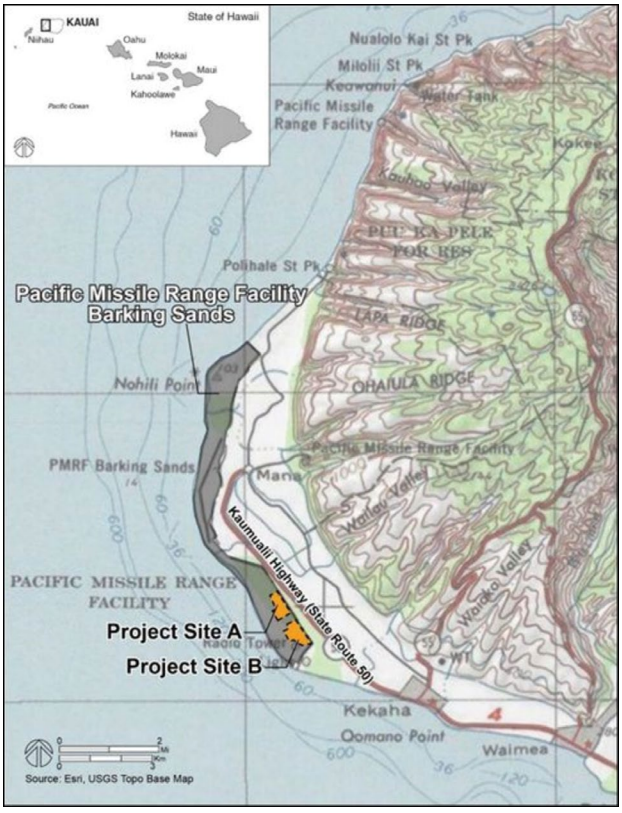
5.1 Pacific Missile Range Facility Barking Sands (Kaua'i, Hawaii)

Docket No. 2017-0443

Summary

The Hawaii Public Utilities Commission (HI PUC) approved a utility-scale solar PV and battery project that is sited on land leased by a cooperative utility from the DoD (see *Figure 5*). The project provides firm renewable electricity to the power grid during normal operations and will serve the installation as an islandable microgrid during power interruptions and during mission critical operations.[12] Construction on the system was completed in December 2020, and a full islanding capability test is planned for the second quarter of 2022.

Figure 5: Sites for the KIUC Solar and Storage Facility at PMRF Barking Sands (Else, 2017)



Base Overview

Pacific Missile Range Facility (PMRF) Barking Sands is a 2,385 acre installation maintained by the Department of the Navy in Kekaha, on the island of Kaua'i, Hawaii. It is the world's largest missile training range (Navy Region Hawaii Commander, n.d.). The base includes over 1,000 square miles of underwater testing, and over 40,000 square miles of managed airspace. DoD has owned this facility since 1940.

Utility Overview

Kaua'i Island Utility Cooperative (KIUC) is an electric cooperative that serves 73,000 customers on the island of Kaua'i, Hawaii (KIUC, 2021). Unlike cooperatives in many states, KIUC is regulated by the state commission. KIUC has set a target to generate at least 70% of its electricity from renewable resources by 2030, which would put it ahead of other utility service territories in achieving the state mandate for 100% renewable electricity by 2045. There are also multiple ongoing regulatory proceedings focused on energy resilience within Hawaii (Kallay, Napoleon, Hall et al., 2021).

12 It should be noted that the PMRF Barking Sands project is an example of defense energy resilience investment, but it would not technically be considered an example of DCEI since the definition under the law is limited to infrastructure within CONUS.

Project Overview

In 2016, the Navy released a request for proposal (RFP) to lease its land (under EUL authority) for the development of a solar and storage facility that would "improve the energy security posture of PMRF Barking Sands." The RFP stated that the Navy did "intend to purchase energy from a proposed project. In lieu of cash rents for a potential lease, the Department of the Navy may seek in-kind consideration in the form of emergency/back-up generation from the proposed project, for use only in the case of a utility grid outage" (NAVFAC, 2016). The RFP also stated that "microgrid infrastructure to enhance energy security" would be "highly desirable" as the in-kind consideration for the lease.

KIUC successfully responded to the RFP and leased 140 acres from the Department of the Navy to site a large solar PV installation and storage project (see the following details). KIUC subleased the land to AES Distributed Energy to develop the project. AES now owns and operates the solar and storage installation. KIUC purchases electricity from the solar and battery system under a 25-year PPA with AES. As called for under the RFP, the PV installation and the battery storage system provide black start and islanding capability to PMRF Barking Sands during power outages as the in-kind contribution for the lease (HI PUC, 2018).

The project includes both on-base generation assets, as well as improvements to the transmission and distribution systems that serve the base (HI PUC, 2017):

- 14 MWAC solar PV installation,
- 70 MWh battery storage system,
- A new substation,
- 0.3 mile 69 kV overhead transmission line to connect the solar project substation to the installation, and
- Two 12.47 kV distribution underground feeders to connect the substation to the main KIUC grid.

Of the 140 acres, 138 acres are used for the PV system and battery, while the remaining 2 acres are used for the PMRF Barking Sands substation.

On average, 73% of the PV system output is used to charge the energy storage system, which dispatches to supply power to the grid during periods of peak system demand. The capacity of the solar and storage facility is substantially larger than the peak demand of PMRF Barking Sands, and the power plant could support the base's load for days on its own without requiring supplemental power from diesel back-up generators. In addition to providing power when the main utility grid is interrupted, the terms of the lease also allows for PMRF Barking Sands to utilize the microgrid capability during mission critical operations for up to 12 hours at a time, not to exceed 12 such requests per year (HI PUC, 2018).

During normal operations the project supplies 7% of KIUC customer annual energy needs, or the equivalent of approximately 6,000 homes (Hawaii State Energy Office, 2021).

The Role of the Commission

In December of 2017, KIUC filed its initial application to HI PUC for their proposed PPA with AES and the PMRF Barking Sands solar and storage project. On June 20, 2018, the HI PUC approved KIUC's application for the PPA. HI PUC concluded that the PPA was reasonable and in the best interest of the public to both add capacity and add new renewable energy generation. The price of $108.50 per MWh was found to be reasonable. HI PUC also approved KIUC's sublease to AES, KIUC's request to build an above-ground transmission line, as well as KIUC's request to spend approximately $8.87 million on the PMRF Barking Sands Substation.

5.2. Davis-Monthan Air Force Base (Tucson, Arizona)

Docket No. L-00000C-20-0007-00186

Summary

The Arizona Corporation Commission (ACC) approved an environmental compatibility certificate for a planned project by Tucson Electric Power (TEP) to expand and upgrade the transmission system in the region surrounding Davis-Monthan Air Force Base (DMAFB). The project, which is scheduled to be in service in 2022, is being undertaken to enhance service reliability for current and new customers, and in response to DoD energy resilience policies and requirements.

Base Overview

DMAFB is located near Tucson, AZ. DMAFB operates the busiest runway in the Air Force, with over 152 aircraft. DMAFB is home to a range of missions and tenants, including, for example, the 355th Fighter Wing (A-10 aircraft), the 55th Electronic Combat Group (EC-130H Compass Call electronic attack aircraft), and units that conduct combat search and rescue missions. The installation is also the location of the "boneyard" for more than 4,000 excess military and government aircraft, which is managed by the 309th Aerospace Maintenance and Regeneration Group. DMAFB contributes an estimated $2.6 billion to the local economy in jobs, wages, and output (Maguire Company, 2017).

Utility Overview

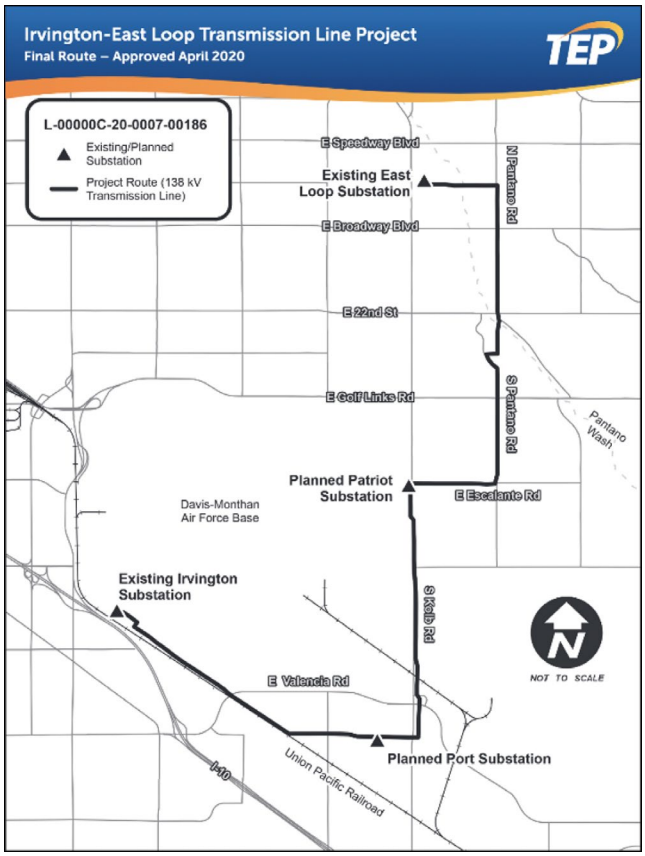
TEP is an IOU and a subsidiary of Fortis. TEP serves 433,000 customers in the Tucson metropolitan area. DMAFB is one of TEP's largest customers.

Project Overview

TEP proposed an upgrade and expansion of its transmission system to improve reliability and resilience for DMAFB and the surrounding communities (*Figure 6*; TEP, 2021). TEP noted that the region to be served by the upgrade has also been identified by Pima County as a high growth area and a focal point of the county's economic development strategy. The transmission project includes:

- Construction of 12.78 miles of new, looped 138 kV transmission line to connect the existing Irvington and East Loop substations.
- Construction of a new port substation near the Port of Tucson.
- Relocation and upgrade of the Patriot substation, which serves DMAFB, and retirement of older substations near the installation.
- Eventual retirement of an aging 46 kV transmission line that would not provide sufficient capacity to serve load growth in the future.

Figure 6: Irvington to East Loop 138 kV Transmission Project (TEP, 2020b)



The project will reduce the risk of transmission system overloading within the region and enhance service reliability for current and new customers. The upgrades will also accommodate the expansion of renewable energy resources in the future (TEP, 2020a). The new Patriot substation will also be fed by two separate 138 kV transmission lines. The addition of a second point of entry for electrical power to DMAFB eliminates the risk to the base of a single point of failure.

TEP and DMAFB are also initiating a Phase II collaboration during which TEP would explore additional energy measures at the base to support critical missions in alignment with DoDI 4170.11, the Air Force's energy resilience requirements, and with DMAFB's own IEP. Phase II would also align with TEP's IRP to produce 70% of its electricity from renewable energy by 2035 (TEP, 2020a), and would explore technologies such as customer-sited energy storage and microgrids. In anticipation of a Phase II collaboration, DMAFB and the City of Tucson made 16 acres around the Patriot substation site available (TEP, 2020a) so that additional energy technology deployment could occur in the future. To accommodate the substation and the potential for future development, the 309th Aerospace Maintenance and Regeneration Group agreed to move 17 C-130 aircraft to a different location within the boneyard (*Figure 7*).

Figure 7: Aircraft Relocation

Source: TEP

The Role of the Commission

On January 15, 2020, TEP applied for a Certificate of Environmental Compatibility with the Arizona Power Plant and Transmission Line Siting Committee. TEP provided testimony that "the decision to move forward with the project was driven by the needs of DMAFB to meet a new DoD mandate regarding energy resiliency" (ACC, 2020a, p. 13). In addition to emphasizing DoD energy policy, TEP also specifically cited the requirements of the Air Force Energy Flight Plan (U.S. Air Force, 2017) to increase the use of energy resiliency technologies and partnerships for critical infrastructure, eliminate single points of failure for facility energy, and eliminate energy shortfalls to improve contingency operations (ACC, 2020a, p. 83). In April 2020, the ACC issued an order approving the certificate, allowing the project to move forward. ACC found that the project was in the public interest because it would enhance the utility's ability to respond to future load growth, provide support to existing distribution substations, and "assist [DMAFB] in fulfilling the DoD … directive for enhancing energy resiliency" (ACC, 2020b).

5.3. Detroit Arsenal Regional Defense Assessment of Resilience

Summary

A January 2019 polar vortex increased demand for natural gas for heating in Michigan at the same time that a fire shut down one of the state's largest natural gas storage and delivery facilities (Whitmer, 2019). The event and resulting supply crisis prompted the governor to direct the Michigan Public Service Commission (MPSC) to assess energy supply vulnerabilities across the state. MPSC subsequently opened Case U-20464 in response to the governor's request. In parallel, DoD, municipalities, manufacturing facilities, and utilities partnered to launch a joint energy resilience planning process in Michigan to address gaps such as those identified in the MPSC assessment. Although no formal proceedings have been opened by MPSC related to the effort, DoD will be actively engaging the MPSC during the regional planning process. This process may have bearing on multiple ongoing MPSC proceedings that were opened following the polar vortex event.

Base and Region Overview

U.S. Army Garrison Detroit Arsenal (DTA) is a 178-acre military installation maintained by the Department of the Army just outside of Detroit in Warren, Michigan. DTA hosts several missions and defense organizations, including the Tank-Automotive and Armaments Command, U.S. Army Combat Capabilities Development Command Ground Vehicle Systems Center, Development and Engineering Center, Defense Logistics Agency, and the Army Contracting Command-Warren, among others.[13]

The larger Southeastern Michigan region is home to more than one third of all residents in the state and includes another strategic military installation—Selfridge Air National Guard Base. The region houses a major industrial corridor, including automotive manufacturing, with both current (COVID-19) and historical (World War II) importance in helping the nation meet manufacturing challenges in times of crisis. The region is also home to a major commercial port, the world's largest supply of fresh water, and a significant defense industry corridor.

Utility Overview

The region's major electricity, natural gas, water, wastewater, and communications utilities will be included as key partners throughout the Detroit Arsenal Regional Defense Assessment of Resilience (DAR2) project. Two different IOUs, Consumers Energy (CE) and DTE Energy, serve DTA. CE and DTE Energy combined serve over 85% of Michigan residents' electricity demand (MPSC, 2019, p. 5). CE also serves approximately 50% of Michigan residents' natural gas needs.

Project Overview

The DAR2 project launched early in 2021 and will run through the spring of 2022. The project was requested by DTA and is being led by Macomb County's Office of Planning and Economic Development with funding from DoD OLDCC and matching funds from the county. Macomb County is working with Idaho National Laboratory (INL) and a team of consultants to conduct an energy resilience analysis for the region that includes DTA and Selfridge Air National Guard Base. In addition to the military partners, the utilities, and state and local government, the project will convene federal partners such as DHS and the Transportation Security Administration. Using the INL All Hazards Analysis (AHA) tool (INL, 2018), the project team will identify and characterize infrastructure interdependencies between critical lifeline sectors in the Southeastern Michigan region, particularly as it relates to defense operations. The AHA tool allows stakeholders to collect publicly available, open-source infrastructure data from the web and then visually represent interdependencies and points of vulnerability between utility sectors in geospatial data layers. After deploying the AHA tool, the project team will convene a stakeholder process with critical infrastructure owners and operators—utilities, major industry, defense, and local government representatives—to design technical, policy, and regulatory

13 DTA also hosts the TACOM Life Cycle Management Command, Program Executive Office Ground Combat Systems, Army Futures Command Cross Function Team Next Generational Combat Vehicle, Program Executive Office Combat Support & Combat Systems Support, and TACOM Integrated Logistics Support Center.

solutions to address the highest priority interdependencies uncovered as part of the team's analysis. The project will then combine the analysis and workshop results into a final study of the region, which will highlight the assessment of man-made and natural threats and vulnerabilities, summarize the interdependency analysis of the regional utilities, and recommend pathways forward.

The DAR2 project builds on a previous effort sponsored by the U.S. Air Force Regional Identification of Gaps in Operational Resilience (OEA, 2020. The Regional Identification of Gaps in Operational Resilience project focused on the Anchorage, AK, region and was centered around critical defense needs at Joint Base Elmendorf-Richardson. Similar to the DAR2 project, INL and its partners analyzed the region using the AHA tool and convened stakeholders to identify cross-sector vulnerabilities and high priority resilience investment opportunities. As a result of the Regional Identification of Gaps in Operational Resilience process, the DOE/OE selected one of the prioritized resilience solutions for future funding and feasibility study (DOE/OE, 2020b). The proposed solution would use a renewable energy microgrid to sustain the operations of the Port of Alaska during prolonged power interruptions.

The Role of the Commission

DTA and Macomb County have stressed the importance of MPSC engagement in the DAR2 project. MPSC regulates electricity, natural gas, and telecommunications utilities.[14] DTA staff convened a briefing for MSPC staff, alongside representatives from CE and staff from the Pentagon, to discuss the project's importance to the larger Southeastern Michigan region.[15] The DAR2 project team will continue to keep MPSC officials apprised of progress and will include the MPSC in the regional infrastructure interdependencies and vulnerabilities analyses and stakeholder process. DTA and its partners will also rely on MPSC's experience producing the 2019 Michigan Statewide Energy Assessment to inform analysis of regional utility vulnerabilities and interdependencies.

14 Excluding cellular, broadband, and internet.

15 Pentagon staff included representatives from Army Installation Management Command, Army Material Command, and the Deputy Chief of Staff, G-9 Installations.

6. Emerging Issues for Regulators

Section Objectives:

- Highlight key issues, barriers, and opportunities that regulators may need to contend with when considering defense energy resilience.
- Provide detailed information on defense energy resilience projects, including the project type, deal structure, stakeholder involvement, and so on.

As shown in the previous sections, the field and practice of defense energy resilience remains nascent as does the role of state utility commissions within it. Going forward, regulators may proactively engage with issues related to defense energy resilience, or they may increasingly see issues related to defense energy resilience integrated into their normal course of business. In either case, there are several uncertainties and unresolved issues that regulators will need to navigate when considering defense-related topics.

6.1. Rate Recovery—Who Pays?

Although many stakeholders are active in areas related to defense energy resilience, clear responsibilities for coordinating and resourcing investments have not been established. The rapidly evolving policy landscape at the federal and state levels has created different avenues to support defense energy resilience, but each has benefits and drawbacks.

- *DoD funding.* DoD has a massive energy budget to acquire the fuel and systems it needs to sustain global operations. DoD's budget for domestic on-base energy improvements, however, is limited compared to the need (Niemeyer, 2018). DoD relies primarily on third-party financing to acquire energy efficiency, renewable energy, and energy resilience. DoD has also not historically had the funds or the authority to make "outside the fence line" investments in community and private sector energy infrastructure on which its installations depend. Although DoD is now able to make investments in planning and infrastructure through OLDCC programs such as MIR and Defense Community Infrastructure Program, these projects are limited compared to the overall need for resilient infrastructure investment.
- *Other federal funding.* There are a broad range of funding programs from federal agencies beyond DoD that could potentially be used to support energy infrastructure projects. These include funds for disaster preparedness and community resilience, for example, from the DOE, U.S. Department of Housing and Urban Development, DHS, and Federal Emergency Management Agency (FEMA). NARUC has convened a Task Force Subcommittee to catalogue the available funds and their applicability to energy resilience, with a guidebook published in fall 2021 (NARUC, 2021). Programs such as FEMA's Building Resilient Infrastructure and Communities have budgets that are an order of magnitude larger than DoD's community programs. Defense energy resilience-related investments could be possible, but the programs serve a broad range of competing uses beyond defense infrastructure and may be difficult to secure. For Department of Housing and Urban Development programs, applicants have had to demonstrate significant community benefit from the proposed project to be eligible. There is also a misalignment of incentives for utility companies to participate in federally funded projects. Utilities may need to invest significant time, effort, and resources into implementing federally funded projects, but they may be unable to make a return on the project once completed if they do not invest ratepayer dollars. The federal government may create blended programs with DoD and other agencies in the future. The Defense Access Roads Program, for example, is a joint program between DoD and the Federal Highway Administration for DoD to pay its share of the cost of public highway improvements required by defense activity (Federal Highway Administration, 2021). Similar programs for DoD to contribute to energy infrastructure do not yet exist.

- *Ratepayer funding.* National security is a public good, and investments in electrical infrastructure to secure critical DoD bases is broadly in the public interest. Utilities are best positioned to make investments in their systems that serve DoD bases, but the extent to which in-state utility ratepayers should carry the cost of defense-relevant infrastructure is unclear. Commissions have rejected ratepayer recovery for some non-DoD energy resilience projects because they served too narrow a geographic area and did not create sufficiently widespread ratepayer benefits (Rickerson, Gillis, and Bulkeley, 2019). Similar arguments could be made to limit investments that benefit DoD installations alone. On the other hand, DoD installations have successfully demonstrated that they are able to use their on-base energy resilience systems to support grid operations during severe weather events to the benefit of regional ratepayers (***Text Box 3***).

Text Box 3. Military Installation Support for Grid Operations

Military-utility energy resilience cooperation can be a two-way street. Just as there have been examples of civilian support for military energy resilience projects, there have been multiple instances during the past several years during which military bases have used their on-base generating assets to support grid stability during severe climate events. Two recent examples involved heat waves in California in 2020 and the polar vortex of 2021:

- *Marine Corps Air Station (MCAS) Miramar.* In August 2020, California ISO issued an alert to reduce energy demand statewide in response to a record breaking heat wave (California ISO, 2020). In response to the alert, San Diego Gas & Electric began hour-long rotating black outs to prevent region-wide power interruptions. MCAS Miramar in San Diego has an installation-wide microgrid that incorporates battery storage, and landfill gas, solar PV, natural gas, and diesel generation (Booth et al., 2020). During the event, MCAS Miramar activated the microgrid to reduce demand on the commercial grid. The base was able to remove 6 MW of its demand from the grid, which helped keep an estimated 3,000 homes online (Carlisle, 2020; Dockery, 2021).
- *Offutt Air Force Base.* A polar vortex in February 2021 brought extreme cold temperatures across the southwestern and midwestern United States. The cold caused widespread power outages across the United States and Mexico and precipitated a power crisis in Texas. In Nebraska, parts of the state experienced temperatures nearing -20 degrees. In Omaha, NE, the Omaha Public Power District contacted Offutt Air Force Base to help alleviate the strain on the grid (Starr and Kaufman, 2021). Offutt Air Force Base activated its on-base power plants and emergency back-up power systems and reduced their demand on the grid by 6 MW. The base utilized its on-site generation assets to support the grid for 75 hours (U.S. Air Force, Offutt Air Force Base, 2021).

6.2. How to Weigh Benefits

As seen in the case studies, utility cost recovery may be most feasible when there are clear benefits for ratepayers above and beyond supporting national security. In the case of PMRF Barking Sands, the project will provide additional energy and capacity to the grid while helping the state cost-effectively achieve its renewable energy target. In reviewing TEP's proposal in the region around DMAFB, ACC recognized the project's broader benefits in its 2021 Order. Additional examples of projects in which commissions have approved military projects based on broader ratepayer and societal benefits can be found in ***Text Box 4***. Text Box 4 also includes a case in which full cost recovery for a defense energy resilience project was not approved.

There are also a range of related, emerging issues that commissions may encounter when weighing the benefits of proposed military resilience projects, including economic development, cybersecurity, equity for disadvantaged communities, and assigning a value for energy resilience or for national security. These emerging topics are discussed in more detail in the sections that follow.

Text Box 4. The Benefits of Military Energy Resilience Projects to Ratepayers

MCAS Yuma. ACC approved a 25 MW diesel microgrid project owned and operated by Arizona Public Service Company and sited at MCAS Yuma under Docket Number E-01345A-16-0036. The project creates ratepayer benefit by cost-effectively providing frequency regulation to the region. ACC leased the land from DoD under an EUL and provides energy resilience to MCAS Yuma as an in-kind capability. During power interruptions, the power plant serves as an islandable microgrid for the base (Klauber et al., 2021, Appen. C). The microgrid entered into commercial operation in December 2016.

Schofield Barracks. In 2015, the HI PUC approved Hawaiian Electric's (HECO's) request for cost recovery for the Schofield Generation Station under Docket No. 2014-0113 (HI PUC, 2015). The Schofield Generating Station is a 50 MW power plant consisting of six reciprocating engines that can burn either diesel fuel or natural gas. As approved, the plant would utilize a minimum of 50% biofuel to satisfy state and military renewable energy requirements. The plant has been fueled with 100% locally refined biodiesel since it came online in 2018 (HECO, 2021). The Army leased land to HECO to build the power plant. During power outages, the plant will be configured to provide power to Schofield Barracks, Wheeler Army Airfield, and Field Station Kunia as an in-kind consideration for the lease (Kallay, Hopkins et al., 2021). The plant is sited outside of the tsunami strike zone and is designed to black start other power plants on Oahu. HI PUC found that the power plant would increase the operational flexibility and reliability of the electricity system, permit the retirement of older generating assets sooner, accommodate increased amounts of renewable energy, and support both state and national security (HI PUC, 2015). HI PUC also found that the power plant "is consistent with the state's commitment to support the military." HECO successfully tested the ability of the power plant to support the military installations in island mode in May 2021, after several years of commercial operations (HECO, 2021).

Naval Construction Battalion Center (NCBC) Gulfport. The Mississippi Public Service Commission approved cost recovery of a PPA for a 4.29 MW PV system located at NCBC Gulfport under Docket No. 2015-UA-65. The PV system, which is owned by a third-party developer, is part of a microgrid that Mississippi Power installed at NCBC Gulfport as part of an EUL with the Navy. The commission cited fuel diversity benefits, long-term downward pressure on rates, and hedging against future carbon compliance costs in support of its decision (Mississippi Public Service Commission, 2015). A successful black start test was completed for the system in June 2021, and the system began commercial operations in August 2021.

Fort Sill Army Base. The Oklahoma Corporation Commission considered an application by the Public Service Company of Oklahoma (PSO) to install an islandable 10.9 MW solar PV system and a 36 MW reciprocating internal combustion engine at Fort Sill under Cause No. PUD 202000097. PSO sought to recover the full cost of both facilities with a return based on its current weighted average cost of capital. The commission only approved limited recovery for the proposed project with a lower return than PSO requested. The commission stated that it "acknowledges the contributions Ft. Sill Army Base ... has made to the security and economy of the State of Oklahoma" and that it "supports the U.S. Army's policy for enhancing its bases' ability to anticipate, prepare for, and adapt to changing conditions as well as withstand, respond, and recover from power disruption (Oklahoma Corporation Commission, 2021)." In its decision to only allow limited recovery, however, the commission stated that it recognizes that the proposed plant would "meet the reliability and resiliency needs of Fort Sill while providing some generation capacity benefits for PSO's general body of customers …," but that if full recovery for PSO were approved, "the overall body of PSO's customers would pay for the project, even though major aspects of the project were intended to provide PSO's new service to Fort Sill."

6.2.1. Military Energy Resilience and Economic Development

DoD payroll spending and contract obligations in all 50 states and DC totaled $550.9 billion in FY19 and accounted for 2.5% of U.S. gross domestic product. DoD spending contributes to a significant share of many state economies. The top three states in terms of DoD contribution to GDP include Virginia (10.6%), Hawaii (7.7%), and Alabama (6.9%; OLDCC, 2019).

As discussed in Section 4.5.2, many states have created military advisory organizations and dedicated funds to enhance the military value of in-state military bases. A primary goal of these efforts is to support DoD's presence in the state and avoid installation closure during future rounds of BRAC. In prior rounds of BRAC, some installations were identified for closure in part because of their exposure to utility power outages from single points of failure (Rickerson et al., 2018). As a result, some states have used their military funds to support energy resilience upgrades at their installations.

The role of economic development within regulatory proceedings is mixed. Although regulators in many states are statutorily able to consider economic impacts as in rulemaking, some commissions are not and may invite litigation if they do so (Zitelman and McAdams 2021). Even if commissions are allowed to consider economic impacts, it does not mean that they will. Recent studies of regulatory decisions related to damage from extreme weather events, for example, found that commissions have not used regional economic impacts in their decision making (Sanstad et al., 2020).

There have not yet been cases in which regulators have specifically taken the economic impact of avoiding base closure into account when considering military energy resilience investments. However, there are some instances in which state regulators have considered base retention when evaluating military renewable energy investments, as described in *Text Box 5*.

Text Box 5. Cost Recovery for Solar PV Systems at Military Installations in Alabama

The Alabama Public Service Commission (Alabama PSC) approved a petition from Alabama Power to build and own a 10.6 MWAC solar PV plant at both Fort Rucker and at Anniston Army Depot in Docket No. 32382 in 2015. Both projects came online in 2017 (OEI, 2019a, 2019b). The approval for the Army PV systems built on a prior Order in the same docket allowing Alabama Power to build and own up to 500 MW of renewable energy. Alabama Power justified its request to partner with the Army in part by citing federal law requiring agencies to procure renewable energy and stating that the PV projects "should help [the installations] avoid unwarranted scrutiny by federal leaders (Alabama PSC, 2015a)." In its Order approving the two Army projects, Alabama PSC cited staff analysis that considered the "direct benefits associated with retaining the military bases load by supporting them in meeting federal mandates associated with renewable energy standards and the indirect benefits associated with retaining residential and commercial loads that are highly dependent on the economic impact of each military base" (Alabama PSC, 2015b). Given the energy resilience policies set by DoD within the last 5 years (Section 3.4), there may be instances in the future in which commissions are asked to consider military energy resilience from an economic development perspective.

6.2.2. Ratepayer Benefits from Cybersecurity

Cybersecurity is a complex issue with important implications for utilities, ratepayers, and national security. Section 6.5 summarizes some of the key issues related to military and civilian cooperation around cybersecurity standards, information sharing, and joint operational capability. Cybersecurity may also have bearing on commissions' consideration of defense energy resilience. Most of the case studies and examples in this report focus on investments in physical electricity infrastructure (e.g., transmission, distribution, and generation). Commissions are increasingly being asked to consider whether the costs of utility investment in cybersecurity measures are just and reasonable, and there are many cases in which commissions have approved ratepayer

investments in cybersecurity. At the same time, significant uncertainties remain related to the effectiveness and prudence of different cybersecurity countermeasures. A recent NARUC study found that "there is no definitive reference ... for cost identification in the cybersecurity domain in the energy sector" and that existing research efforts "offer hardly any hints of how costs may be allocated" (Ragazzi et al., 2020). Despite current uncertainties, the imperative exists to identify military and civilian co-benefits from cyber-related investments as the regulatory framework for cybersecurity evolves. Cybersecurity within the electricity system requires asset-level investments, as well as investments in the centralized control capabilities of utilities. Although asset-level investments at military installations may face scrutiny as to whether they benefit ratepayers broadly, cybersecurity investments in central automated systems that serve DoD installations would likely also create benefits for civilian customers across utility service territories.

6.2.3. Equity and Disadvantaged Communities

State commissions are investigating issues related to equity and environmental justice for low-income, energy-burdened communities (DeVar et al., 2021), even as some state governments are expanding their equity-related intervention in regulatory proceedings (e.g., Whitmer, 2020). Disadvantaged communities bear a disproportionate share of the negative impacts of energy system disruptions and climate change. They may also face negative impacts (e.g., job loss) from the transition away from fossil fueled-energy, and challenges to accessing the benefits of the emerging energy economy. As regulators explore avenues to equitably serve disadvantaged communities, there may be opportunities to anchor such efforts alongside defense energy resilience initiatives. Many military installations are located in rural and remote areas in which the surrounding communities lack access to basic services (GAO, 2021). Military installations are also located adjacent to low-income neighborhoods where residents live at or below the poverty line (Meadows et al., 2013). DoD recognizes that the well-being of military families that live on and around military installations is an important component of readiness. One of the key tenets of the Marine Corps' Installations Energy Strategy, for example, is to "ensure a secure and reliable energy supply to support the operating forces and their families through the prudent management of energy resources and infrastructure" (U.S. Marine Corps, 2013). As described in Section 4.3.1, programs such as those offered by OLDCC may offer opportunities for states to make energy resilience investments that support the objectives of military-community partnerships and align efforts to support military families with support to neighborhoods within defense communities.

6.2.4. Quantifying the Value of Resilience

Utility investments in defense electric infrastructure can create a resilience value that accrues to a broad range of stakeholders above and beyond the economic development benefits discussed in the previous section. State commissions have emphasized the need for a quantitative resilience value to support rulemaking, rate making, and emergency planning (California PUC, 2020; MPSC, 2019). The value of resilience is typically acknowledged to be significant, but notoriously difficult to quantify. There have been many attempts to identify a resilience value that can be used to support energy decision making, but the energy industry has not adopted a standard approach (Electric Power Research Institute, 2021). The practice of integrating energy resilience into regulatory benefit-cost analysis remains at an early stage (Kallay, Letendre et al., 2021), and NARUC research found that a quantified value of resilience has not been considered in commission energy resilience proceedings (Rickerson et al., 2019). Research into the value of resilience is ongoing, however, and both commissions and utility stakeholders will likely continue to attempt to integrate resilience into regulatory proceedings in the future. When considering defense energy investments, there are (at least) four perspectives on the value of resilience that may be relevant—and that should be distinguished from each other:

- ***Local military value.*** Local military value refers to the value to the military of avoiding long-term power interruptions at a specific installation. There have been attempts to assess a value of resilience at specific bases by using, for example, the avoided cost of diesel generators or surveys of military installation personnel (Giraldez et al., 2012; Marqusee, Schultz and Robyn, 2017). DoD has not adopted a standard

methodology for quantifying energy resilience, however, and recent research sponsored by the Air Force recommended that resilience valuation be elicited from DoD mission owners on a case-by-case basis (Narayanan et al., 2019). Establishing a local value of resilience could help DoD prioritize where it should focus resilience investment efforts across its portfolio. A local value on its own, however, may not support utility investment in defense energy resilience, since the values would accrue primarily to the specific installation rather than to ratepayers more broadly.

- *Regional value.* A value of resilience may be applicable to military installations if the installations benefit from energy resilience upgrades alongside ratepayers within a specific geographic area and/or utility service territory. The New York State Energy Research and Development Authority, for example, funded microgrid feasibility studies across New York State. The feasibility study for Stewart Airport and the Town of New Windsor considered a microgrid that would serve civilian critical facilities as well as military aviation hangars. The benefit-cost analysis for the study included consideration of "major power outage benefits" related to the value of keeping both military and civilian facilities operational during power interruptions (NRG, 2016). Regional resilience solutions that include both civilian and military facilities have not yet been formally considered by state commissions.
- *State emergency management value.* As discussed in Section 1.1, DoD plays multiple roles in state-level disaster preparedness and emergency response. Governors frequently activate National Guard units to support emergency response efforts both within their own states and in support of other states through the Emergency Management Assistance Compact with other governors. If the scale or severity of the emergency requires it, states may also request that active-duty military units be deployed to support state efforts under Defense Support to Civil Authorities. Active duty and National Guard installations may also serve as landing sites for relief aircraft and staging areas for federal and state emergency management equipment and personnel. A value for the state emergency response function of DoD has not been clearly quantified for use in benefit-cost analyses. FEMA does quantify the value of police, fire, and medical services for use in its hazard mitigation benefit-cost analyses (FEMA, 2016), however, and similar consideration could be applied to DoD's emergency response functions.
- *National security value.* Assuring the energy supply of critical installations and missions adds enormous value to national-level security. There is currently, however, no accepted method or standard for quantifying the value of sustaining military operations. In the past, some states have used a national security benefit to evaluate programs that reduce foreign fuel imports, using the argument that reduced oil consumption reduces the need for the military to defend U.S. oil supply internationally (e.g., NMR Group, 2011). More recently, however, states have moved away from recognizing this benefit. In 2013, for example, the Massachusetts Department of Public Utilities found that the national security benefit did "not accrue specifically to program participants but are realized more broadly by all citizens" and therefore should not be included in the energy efficiency program cost test (MA Department of Public Utilities, 2013). DoD prioritizes installations based on the presence of defense critical assets and task critical assets, which are essential to the execution of operational plans that support national security functions; however, priority installations have not been assigned explicit cost or economic values that can be utilized for this purpose. Instead, they can help identify installations of particular value or interest to DoD, but the specific asset designations are classified information and cannot be used in public proceedings.

6.3. Utility and DoD Collaboration

Despite the activity related to defense energy resilience described in the previous sections, coordination and collaboration between utilities and the military remain a challenge. The stakeholder convening processes and venues necessary to have constructive dialogue around defense energy resilience planning are complex and new. There are several barriers to coordination and collaboration that will need to be addressed as the defense energy resilience conversation evolves:

- *Information exchange.* The list of designated CDFs is designated as CEII, and so it will be difficult for civilian authorities to acquire the information and collaborate directly with defense energy resilience initiatives. Information security issues are addressed in greater detail in Section 6.4.
- *DoD capacity and communication.* DoD does not have an organized, outward-facing focus on the critical infrastructure that serves its bases, and it lacks dedicated staff, capabilities, or processes to assess the utility systems. DoD also does not have a standardized practice for engaging with utilities (or regulators) in evaluating vulnerabilities outside the fence line. DoD does participate in the FRIWG in utility rate cases, but intervention is often reactive and rarely focuses proactively on energy resilience. The DoD energy program offices do engage with utilities, regulators, and state policy makers, but this engagement tends to focus primarily on inside the fence line project development, rather than outside the fence line partnerships.
- *Requirements and metrics.* DoD's focus on energy resilience is driven by mission assurance, that is, the need to assure that critical missions are successful. This mission-oriented focus on energy resilience is very different from utilities' focus on reliability. Even if information sensitivity was not an issue, there is not currently a "shared language," standard format, common set of metrics, or an established channel through which DoD can communicate its energy resilience requirements to utilities in a manner that utilities can include in their planning and use in regulatory proceedings.

6.4. Secure Communications and Decision Making

Communications surrounding defense energy resilience can be challenging, especially when concerning a private or public sector partner who needs data to serve their military installation. As digitalization of assets and communications increases, vulnerabilities surrounding the exposure of sensitive information are becoming even more widespread and acute, rendering historical challenges in communications even more fraught. For regulators, those challenges include the complicated nomenclatures used in the public and private sectors for critical infrastructure (Section 2.1), inconsistencies across DoD installations in their communications outside the fence line, and in the risk of exposure of sensitive information inherent to operating in the public domain.

Secure information sharing standards exist at a variety of levels for both the DoD and the utilities that serve them, and this complexity impedes energy systems projects that require cross-sector communication. DoD has established policy for information classification and controlled distribution through DoDD and DoDI, but there is no standard DoD classification guidance for energy-related information (USD(I&S), 2014, 2016). As a result, classification is interpreted on a case-by-case basis at the installation level by the base commander and mission owners. Outside the fence line, standards of information sharing surrounding critical infrastructure have evolved over time. In 2002, Congress passed a Critical Infrastructure Information Act, which created the Protected Critical Infrastructure Information Program and used the Critical Infrastructure Information terminology to refer to "information not customarily in the public domain and related to the security of critical infrastructure or protected systems" (6 U.S.C. § 651-674, 2018). More recently, the FAST Act created CEII, which as a subset of CUI is exempt from disclosure under the Freedom of Information Act. As discussed in previous sections, CEII includes information about a system or asset of the bulk-power system that, if destroyed or incapacitated, would negatively affect U.S. national security.

There may be concern among regulators that their exposure to sensitive information surrounding DCEI, even if securely communicated, could result in a number of challenges related to their status as public servants. NARUC has explored the fact that commissions can be subject to Freedom of Information Act filings due to their role in the public domain (e.g., NARUC, 2007). To avoid disclosing sensitive information, regulators can develop clear distinctions between types of information and their respective sensitivities, to avoid litigation on the basis of "overbroad" definitions.

Even with clear communications about information sensitivity, handling confidential information creates challenges for commissions. MPSC noted as part of the State Energy Assessment that "concerns about protecting confidential critical infrastructure information created time-consuming delays to create a work-around which would protect the data while staff reviewed the information. Currently there is no law providing protection. The commission finds that legislation is needed to provide protection of critical energy infrastructure information to enhance information sharing with state agencies for emergency response preparedness efforts" (MPSC, 2019). The protected sharing of information is essential to the successful execution of defense energy resilience programs and must be resolved to the satisfaction of the parties at the state and federal level as well as the private sector.

6.5. Cybersecurity and Utility-Military Cooperation

The accelerating frequency of cyber attacks and increasing sophistication of both state actors and ransomware described in Section 1.2 necessitates a more detailed consideration of the cybersecurity aspects of defense energy resilience. Utilities occupy a unique position within the landscape of critical infrastructure owner/operators as the only sector with mandatory cybersecurity compliance standards. However, adherence to these standards alone does not ensure the secure delivery of electricity services required by DoD. These issues are highlighted in NARUC's report, *Understanding Cybersecurity Preparedness: Questions for Utilities* (Costantini and Acho, 2019) and the supporting Cybersecurity Preparedness Evaluation Tool (Cadmus Group LLC, 2019), which emphasize the use of the National Institute of Standards and Technology cybersecurity framework for utilities to develop more comprehensive security strategies. Specific to defense energy resilience there are three areas in which cyber risk and mitigation have touch points relevant to DoD and industry partners: compliance and standards, information sharing, and joint operational capability.

- *Compliance and Standards.* Electric utilities are subject to the compliance standards identified in North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection (CIP)-8, which governs cyber incident reporting and response planning (NERC, 2019). This includes detailed requirements for the protection of hardware and software systems critical to real-time grid operations and includes financial penalties for noncompliance. CIP-8 is the result of a decades-long process of evolving industry best practices into voluntary standards prior to full implementation. In parallel to the NERC CIP-8 standards, DoD recently launched the Cybersecurity Maturity Model Certification (CMMC), designed to address supply chain risks associated with essential physical and IT components used by Defense Industrial Base companies. While the electricity industry provides direct services to the DoD, they are not categorized as part of the Defense Industrial Base. However, there is currently consideration to include utilities in the CMMC program, though the legal and economic impacts of implementation are not clear. The CMMC establishes a certification standard for defense contractors that operate systems containing DoD information, but do not connect to the DoD network. In contrast, DoD's Risk Management Framework is used by DoD to mitigate the cybersecurity risk of systems that are either owned by the DoD and/or connected to DoD networks (DoD, 2014). In addition, the Risk Management Framework requires approval for individual systems instead of the company-wide approval required by CMMC.
- *Information Sharing.* Beginning with the formation of the Electricity Information Sharing and Analysis Center, an industry-funded organization to facilitate the exchange of threat information between government and the energy sector, there have been several efforts to improve utility access to sensitive

or classified threat information from the U.S. intelligence community. The Cyber Risk Information Sharing Program, managed by DOE, is designed to collect real-time network data from the energy sector for analysis by the U.S. intelligence community to detect malware and network anomalies introduced by threat actors.

- *Joint Operational Capability.* Recent efforts to develop a shared cyber operational response between the federal government and the energy sector resulted in the aforementioned Section 9 program, as well as the Pathfinder agreement (DOE, 2020c) between DOE, DHS, and DoD to provide interagency support to utilities in the form of technical capabilities, incident management, and capabilities alignment. These programs facilitated the engagement of the Cyber Mutual Assistance (CMA) program developed by the Electric Subsector Coordinating Council and Joint Operational Playbooks to align the tactics, techniques, and procedures of cyber capabilities within the public and private sector.

7. Next Steps

Section Objectives:

- Identify proactive steps that regulators could take to deepen their understanding of defense energy resilience issues.
- Highlight opportunities for regulators to productively engage with in-state DoD stakeholders.

There is not yet a playbook or set of established practices for how state regulators, utilities, and the DoD should collaborate around defense energy resilience. Given the uncertainties related to the issues described in Section 6, some commissions may adopt a "wait and see" approach to give time for the ongoing programs and initiatives described in Section 4 to mature. Some commissions, however, may wish to proactively define the practices and processes by which utilities and military installations collaborate. This section provides examples of initial steps that regulators could take to engage with defense energy resilience.

- *Assess in-state DCI.* Regulators can identify the military installations in their state and review the extent to which DoD bases are served by regulated utilities. This assessment could be limited to electricity infrastructure or could also include a review of how additional sectors that commissions regulate serve in-state defense facilities. Approaches to an assessment would have to take into account information sharing restrictions on a state-by-state basis.
- *Engage with in-state DoD representatives and activity.* Regulators can engage the staff of in-state military installations to identify planned or ongoing energy resilience projects that may rise to the level of commission consideration—or identify gaps and concerns from the installation perspective related to utility service. Regulators could also engage with the relevant energy program offices of each military service.
- *Initiate an investigative docket.* Commissions in some states can initiate dockets that are informational in nature. Energy resilience is a broad term, encompassing many potential strategies, technologies, and operational adjustments at scales ranging from individual loads up to the bulk-power system. Commissions could open proceedings to investigate, for example, the current status of utility and military partnership within the state, the nature and duration of outages experienced by military facilities, opportunities to include projects with military co-benefits in integrated resource planning, or options for low-cost or no-cost resilience improvements. Adding DoD sites to black start crank paths or to the bottom of load shed lists, for example, represent lost-cost ways to improve the resilience of defense facilities.[16]
- *Explore the development of joint energy resilience metrics.* There are multiple ongoing efforts to identify metrics that can be used for resilience planning, and for utility energy resilience specifically (Anderson et al., 2017; Kallay, Napoleon, Havumaki et al., 2021). Regulators can review and engage with these efforts as they develop. As a starting point, however, regulators could convene basic and high-level conversations with utilities and the military to develop a shared lexicon around how military requirements translate into utility infrastructure. Certain DoD mission types, for example, have specific energy needs. Quick reaction forces that must deploy to anywhere in the world, for example, might require 24 hours of uninterruptible power, which could have implications for the fuel supply and fuel flexibility of the power plants serving the base. Similarly, an installation with flight operations might require a significant amount of power in a short period of time with limited notice, which could have implications for the ramping capabilities of the generation serving that facility. Similar conversations that map requirements to infrastructure could engage the transmission and distribution systems that link power generation to military installations, touching upon topics like the number of intermediate substations, the physical hardening of transmission and distribution lines, and so on. Such conversations can help determine which infrastructure could be the focus of resilience assessments and investments.

16 In 2020, DOE issued the Prohibition Order Securing Critical Defense Facilities, which required utilities that serve CDFs to designate CDFs as "priority load in the applicable load shedding and system restoration plans" (DOE, 2020b, p. 534). The Prohibition Order was subsequently revoked in April 2021 by DOE as part of a broader review and suspension of Executive Order 13920 (DOE, 2021).

- *Convene and/or participate in value of resilience investigations.* There are multiple, ongoing efforts to explore the value of resilience that are being led by the national laboratories and by the utility industry. In the near-term, regulators can engage with these initiatives to assess emerging methodologies and provide feedback on potential use cases. Regulators can also commission their own studies of the value of resilience and work with utilities to integrate them in benefit-cost analyses. There may also be opportunities for regulators to contribute to discussions specifically on the value created by defense energy resilience investments as DOE and DoD continue to define the national security value of DCEI.
- *Map military installations and disadvantaged communities.* Military installations may be located within or nearby low-income and energy-burdened communities. Regulators that are investigating issues such as energy resilience equity and environmental justice could identify whether disadvantaged communities are located adjacent to in-state military installations. Communities that share resilience risks with DoD installations provide opportunities for mutually beneficial energy resilience investments with the potential to leverage DoD community investment funds.
- *Investigate defense energy-related cybersecurity investments.* Given the ambiguities around the comparative benefits and costs of cybersecurity countermeasures, regulators have the opportunity to work with in-state military installations to anchor investigations into the effectiveness of cybersecurity strategies. State commissions could use engagement with military installations as a means to explore the relationship between local, asset-level cybersecurity investments and investments in centralized cybersecurity solutions, including the comparative scale of investment required and the breadth of shared benefits created for ratepayers and DoD infrastructure.
- *Engage in planned or ongoing defense-relevant projects.* Projects such as the planned EEI-Army pilots and the MIR projects funded by OLDCC represent opportunities for commissions to engage with and learn alongside the communities, utilities, state agencies, and defense agencies. Commissions could also provide guidance or checklists to the proponents of ongoing efforts about how to best prepare to have productive regulatory engagement as their projects mature.
- *Explore secure communications frameworks.* Future work in the defense energy resilience space will need to include policy development on how regulators can best engage in secure communications and decision making as they address the issues outlined in this report. Some analogues to a potential regulatory communication method for secure information sharing do exist, such as the NERC Critical Infrastructure Protection (CIP)-014 requirements for utilities. NERC CIP-014, accomplishes two key objectives, the first of which is allowing utilities to "identify and protect transmission stations and transmission substations, and their associated primary control centers, that if rendered inoperable or damaged as a result of a physical attack could result in widespread instability, uncontrolled separation, or cascading within an interconnection" (NERC, 2014). CIP-014 also functions as an information classification process aimed primarily at requiring owners and operators to enact procedures to protect confidential or sensitive information related to grid assets of this type. Methods to do so include making documents confidential, keeping information in a controlled location on-site, securely storing information and destroying it when no longer needed, and requiring counsel to sign-off on release of information to outside entities (NERC, 2014, p. 28, Parts 2.4 and 6.4). CIP-014 pertains primarily to information sharing by transmission operators in so far as it exposes the physical security of transmission assets. However, this information classification process is also used as a means for utilities to communicate risk to the Federal Energy Regulatory Authority when planning infrastructure upgrades and additional security investments. System owners categorize assets using violation security levels to indicate areas of high priority for investment and risk mitigation without the need for open disclosure of vulnerabilities in the public forums utilized for more common reliability or efficiency-driven infrastructure projects. The CIP-14 model of communication of sensitive information could provide a model for regulators and installations in their collaborative efforts.

References

6 U.S.C. § 651-674. (2018). Cybersecurity and Infrastructure Security Agency.

10 U.S.C. 2391. (2018). Military Base Reuse Studies and Community Planning Assistance.

10 U.S.C. § 2667. (2018). Leases: Non-excess Property of Military Departments and Defense Agencies.

10 U.S.C. § 2668. (2018). Easements for Rights of Way.

10 U.S.C. § 2913. (2018). Energy Savings Contracts and Activities.

10 U.S.C. § 2922a. (2018). Contracts for Energy or Fuel for Military Installations.

16 U.S.C. § 791-826c. (2018). Federal Regulation and Development of Power.

Air Force Community Partnership Program. (2016). Quick Reference Guide (v. 14). Washington, DC: U.S. Air Force.

Alabama Public Service Commission. (2015a). Order (Docket No. 32382). Montgomery, AL.

———. (2015b). Order (Docket No. 32382). Montgomery, AL.

Anderson, D., A. Eberle, T. Edmunds, J. Eto, S. Folga, S. Hadley, G. Heath, et al. (2017). "Grid Modernization: Metrics Analysis (GMLC1.1)" (PNNL-26541). Richland, WA: Pacific Northwest National Laboratory.

Arizona Corporation Commission (ACC). (2020a). "Notice of Filing of Direct Testimony and Exhibits of Tucson Power Company." Phoenix, AZ.

———. (2020b). Order (Decision No. 77601). Phoenix, AZ.

Association of Defense Communities. (2019). "Implementing the Defense Community Infrastructure Program: A Survey of Projects Ready to Enhance Military Value." Washington, DC.

Booth, S., J. Reilly, R. Butt, M. Wasco, and R. Monohan. (2020). "Microgrids for Energy Resilience: A Guide to Conceptual Design and Lessons from Defense Projects" (NREL/TP-7A40-72586). Golden, CO: National Renewable Energy Laboratory.

Burke, S., and S. McNeil. (2015). *Toward a Unified Military Response: Hurricane Sandy and the Dual Status Commander.* Carlisle, PA: Strategic Studies Institute, Army War College.

Cadmus Group LLC. (2019). "Cybersecurity Preparedness Evaluation Tool." Washington, DC: National Association of Regulatory Utility Commissioners.

California Energy Commission. (2016, October 13). "Navy and Energy Commission Formalize Energy Partnership." Sacramento, CA.

California Governor's Military Council. (2015). "Maintaining and Expanding California's National Security Mission." Sacramento, CA.

California Independent System Operator. (2020). "Flex Alert Issued for Next Four Days, Calling for Statewide Conservation." Folsom, CA.

California Public Utilities Commission. (2020, July 23). "Administrative Law Judge's Ruling Requesting Comment on the Track 2 Microgrid and Resiliency Strategies Staff Proposal, Facilitating the Commercialization of Microgrids Pursuant to Senate Bill 1339" (Rulemaking 19-09-009—Order Instituting Rulemaking Regarding Microgrids Pursuant to Senate Bill 1339 and Resiliency Strategies). San Francisco, CA.

Carlisle, C. (2020, August 19). "MCAS Miramar Uses Renewable Energy to Prevent Blackouts." ABC 10News. San Diego, CA.

Connecticut Office of Military Affairs. (2020). "Annual Report Fiscal Year 2019–2020." Rocky Hill, CT.

Cooperative.com. *(n.d.).* "Electric Co-ops and the Military, Working with the Military."

Costantini, L., and M. Acho. (2019). "Understanding Cybersecurity Preparedness: Questions for Utilities." Washington, DC: National Association of Regulatory Utility Commissioners.

Cybersecurity and Infrastructure Security Agency (CISA). (2016). "ICS Alert (IR-ALERT-H-16-056-01) Cyber-Attack Against Ukrainian Critical Infrastructure." Washington, DC: U.S. Department of Homeland Security.

———. (2018). "Support to Critical Infrastructure at Greatest Risk ("Section 9 Report") Summary." Washington, DC: U.S. Department of Homeland Security.

DeCesaro, J., and J. Zetterberg. (2020, October 14). "Defense Critical Electric Infrastructure." Presented to the U.S. Department of Energy Electricity Advisory Committee Meeting, Washington, DC.

Devar, S. and T. Lanckton. (2021, January). "Justice in 100 Metrics: Tools for Measuring Equity in 100% Renewable Energy Policy Implementation." Boston: Initiative for Energy Justice

Dockery, C. (2021, June 17). "Opinion: Miramar's Innovative Microgrid Supports National Defense and Our San Diego Neighbors." Times of San Diego.

Edison Electric Institute (EEI). (2019). "Department of Defense & Federal Government." Washington, DC.

Electric Power Research Institute. (2021). "Value of Resilience White Paper." Palo Alto, CA.

Else, J. (2017, February 28). "PMRF Solar Project Could Make Island Self-Sufficient." *The Garden Island.*

Executive Order No. 12003, Energy Policy and Conservation. (1977, July 20).

Executive Order No. 12788, Defense Economic Adjustment Program. (1992, January 15).

Executive Order No. 13378, 70 Fed. Reg. 28413. (2005, May 12).

Executive Order No. 13920, 85 Fed. Reg. 26596. (2020, May 1).

Executive Order No. 13990, 86 Fed. Reg. 7037. (2021, January 20).

Executive Order No. 14008, 86 Fed. Reg. 7619. (2021, January 27).

Federal Acquisition Regulation, 48 C.F.R. § 41.103-41.2. (2019).

Ferris, N., and S. van Renssen. (2021, February 21). "Cybersecurity Threats Escalate in the Energy Sector." Energy Monitor.

Florida Public Service Commission. (2018). "The Federal Executive Agencies Petition to Intervene" (Docket 20170179-GU). Tallahassee, FL.

Giraldez, J., S. Booth, K. Anderson, and K. Massey. (2012). "Valuing Energy Security: Customer Damage Function Methodology and Case Studies at DoD Installations" *(NREL/TP-7A30-55913).* Golden, CO: National Renewable Energy Laboratory.

Grants.gov. (2021). "OLDCC-21-F-0002 Defense Community Infrastructure Program Department of Defense Office of Local Defense Community Cooperation." Arlington, VA.

Greenley, H. L. (2019). "Department of Defense Energy Management: Background and Issues for Congress" (R45832). Washington DC: Congressional Research Service.

Hawaiian Electric (HECO). (2021). "Hawaiian Electric Microgrid Powers Three Central Oahu Army Installations During Test of Energy Resilience." Honolulu, HI.

Hawaii Public Utilities Commission. (HI PUC). (2015). Decision and Order No. 33178. Honolulu, HI.

———. (2017). Docket No. 2017-0443. Honolulu, HI.

———. (2018). Decision and Order No. 35538. Honolulu, HI.

Hawaii State Energy Office. (2021). "Hawaii Energy Projects Directory." Honolulu, HI.

Herrera, G. J. (2020). "The Defense Community Infrastructure Pilot Program (DCIP): FY2020 Funding and Approved Projects" (IN11505, Version 2). Washington, DC: Congressional Research Service.

Holly, D. (2019). "Department of Energy Honors Co-op Solar and Storage Project at Hawaii Naval Base." Arlington, VA: National Rural Electric Cooperative Association.

H.R.22—114th Congress (2015–2016): Fixing America's Surface Transportation Act. (2015, December 4). https://www.congress.gov/bill/114th-congress/house-bill/22/text

H.R.2810—115th Congress (2017–2018): National Defense Authorization Act for Fiscal Year 2018. (2017, December 12).

H.R. 5515—115th Congress (2017–2018): John McCain National Defense Authorization Act for Fiscal Year 2019. (2018, August 13).

Idaho National Laboratory (INL). (2018). "All Hazards Analysis" (video). Idaho Falls, ID.

ISO New England. (2018). "Operational Fuel-Security Analysis." Holyoke, MA.

Kallay, J., A. Hopkins, C. Odom, J. Ramey, J. Stevenson, R. Broderick, R. F. Jeffers, and B. M. Garcia. (2021). "The Quest for Public Purpose Microgrids for Resilience: Considerations for Regulatory Approval" (SAND2021-8207). Albuquerque, NM: Sandia National Laboratories.

Kallay, J., S. Letendre, T. Woolf, B. Havumaki, K. Shelley, A. Hopkins, R. Broderick, R. Jeffers, and B. M. Garcia. (2021). "Application of a Standard Approach to Benefit-Cost Analysis for Electric Grid Resilience Investments" (SAND2021-5627). Albuquerque, NM and Livermore, CA: Sandia National Laboratories.

Kallay, J., A. Napoleon, B. Havumaki, J. Hall, C. Odom, A. Hopkins, M. Whited, et al. (2021). "Performance Metrics To Evaluate Utility Resilience Investments" (SAND2021-5919). Albuquerque, NM: Sandia National Laboratories.

Kallay, J., A. Napoleon, J. Hall, B. Havumaki, A. Hopkins, M. Whited, T. Woolf, et al. (2021). "Regulatory Mechanisms to Enable Investments in Electric Utility Resilience" (SAND2021-6781). Albuquerque, NM: Sandia National Laboratories.

Kaua'i Island Utility Cooperative (KIUC). (2019). "Strategic Plan Update." Kaua'i, HI.

———. (2021). "Energy Information." Kaua'i, HI.

Kidd, R. (2017). "Threats to Posts: Army Must Rethink Base Security." Washington DC: Association of the U.S. Army.

Klauber, A., J. Cathcart, L. Shwisberg, I. Toussie, N. Adib, F. Kelsey, S. Mitchell, Z. Pecenak, M. Stadle, W. Rickerson, M. Pringle, S. Barrett, and J. Crites. (2021). "Airport Microgrid Implementation Toolkit." Washington, DC: National Academies of Sciences.

Kleim, J. (2016, May 18–19). "Renewable Energy Program Office." Presented at the Federal Utility Partnership Working Group 2016 Spring Seminar, Cincinnati, OH.

———. (2017, April 12). "Resilient Energy Program Office: The Department of the Navy's Energy Resiliency Progress." Presented at the Federal Utility Partnership Working Group 2017 Spring Seminar, Savannah, GA.

———. (2019, December 10). "Energy Security Programs Office (ESPO)." Presented at the Association of Defense Communities Energy & Water Forum, Washington, DC.

Maguire Company. (2017). "Economic Impact of Arizona's Principal Military Operations." Phoenix, AZ: Arizona Military Affairs Commission.

Marqusee, J., C. Schultz, and D. Robyn. (2017). "Power Begins at Home: Assured Energy for U.S. Military Bases." Reston, VA: Noblis. Commissioned by The Pew Charitable Trusts.

Massachusetts Department of Energy Resources and MassDevelopment. (2014). "Clean Energy Assessment and Strategic Plan for Massachusetts Military Installations." Boston, MA.

Massachusetts Department of Public Utilities. (2013). "DPU Order Approving 2013-2015 Three-Year Efficiency Plans." Boston, MA.

McGhee, M. (2019, February 10). "Office of Energy Initiatives." Presented at the 2019 NARUC Winter Policy Summit, Washington, DC.

Meadows, S. O., L. L. Miller, J. N. V. Miles, G. C. Gonzalez, and B. T. Dues. (2013). "Exploring the Association Between Military Base Neighborhood Characteristics and Soldiers' and Airmen's Outcomes." Santa Monica, CA: Rand Corporation.

Michigan Public Service Commission (MPSC). (2017). Order (Case No. U-20463). Lansing, MI.

———. (2019). "Statewide Energy Assessment Final Report." Lansing, MI.

———. (2020). "MPSC Statewide Energy Assessment." Lansing, MI.

Mississippi Public Service Commission. (2015). Final Order (Docket No. 2015-UA-65). Jackson, MS.

Narayanan, A., D. Knopman, K. Van Abel, B. M. Miller, N. Burger, M.V. Merrill, A. D. Rothenberg, L. Muggy, and P. Mills. (2019). "Valuing Air Force Electric Power Resilience: A Framework for Mission-Level Investment Prioritization." Santa Monica, CA: Rand Corporation.

Narayanan, A., J. Welburn, M. Miller, S. Li, and A. Clark-Ginsberg. (2020). "Deterring Attacks Against the Power Grid." Santa Monica, CA: Rand Corporation.

National Association of Regulatory Utility Commissioners (NARUC). (2007). "Information Sharing Practices in Regulated Critical Infrastructure States Analysis and Recommendations." Washington, DC.

———. (2020). "Task Force on Emergency Preparedness, Recovery and Resiliency Charter." Washington, DC.

———. (2021). "Federal Funding Opportunities for Pre- and Post-Disaster Resilience." Washington, DC.

National Centers for Environmental Information. (2020). "U.S. Billion-Dollar Weather and Climate Disasters, 1980–Present" (NCEI Accession 0209268) [Data set]. Silver Spring, MD: National Oceanic and Atmospheric Administration.

National Conference of State Legislatures. (2016). "Preparing for Duty, State Policy Options to Sustain Military Operations." Washington, DC.

National Rural Electric Cooperative Association. (2020). "Cooperative Engagement with the Military." Washington, DC.

Navy Region Hawaii Commander. (n.d.). "Pacific Missile Facility Guide Installation Guide." Kekaha, HI.

Niemeyer, L. (2018). "Statement of Honorable Lucian Niemeyer, Assistant Secretary of Defense (Energy, Installations and Environment)." Washington, DC: House Committee on Armed Services Subcommittee on Readiness.

NMR Group. (2011). "Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation." Madison, WI: Tetra Tech. Prepared for Massachusetts Program Administrators.

North American Electric Reliability Corporation (NERC). (2014). "Physical Security." Washington, DC.

———. (2019). "Cyber Security Incident Reporting and Response Planning." Washington, DC.

NRG. (2016). "Stewart Airport-New Windsor Community Microgrid: Microgrid Feasibility Study." Albany, NY: New York State Energy Research and Development Authority.

Oklahoma Corporation Commission. (2021). Order No: 718758 (Cause No. PUD 202000097). Oklahoma City, OK.

Orange County, New York. (2021). "Request for Proposals: Military Installation Resiliency Study" (RFP-PLA03-21). Goshen, NY.

Partain, S. (2020). "Serving Resilience: Supporting Military Installations." Arlington, VA: American Public Power Association.

Paulmann, J. A., J. Malueg, C. C. Eitler, J. White, C. Hurley, and N. Shippee. (2020). "Advancing Resilience for Defense Communities." Washington, DC: Association of Defense Communities and Stantec.

Public Utility Commission of Texas. (2019). The Department of the Navy's Motion to Intervene (PUC Docket 49494). Austin, TX.

Ragazzi, E., A. Stefanini, D. Benintendi, U. Finardi, and D. Holstein. (2020) "Evaluating the Prudency of Cybersecurity Investments: Guidelines for Energy Regulators." Washington DC: National Association of Regulatory Utility Commissioners.

Rickerson, W., W. Gillis, and M. Bulkeley. (2019). "The Value Of Resilience For Distributed Energy Resources: An Overview Of Current Analytical Practices." Prepared for National Association of Regulatory Utility Commissioners. Washington DC: Converge Strategies.

Rickerson, W., T. McDonald, M. Wu, and C. Murray. (2020). "Mission Essential: Energy Resilience for the U.S. Department of Defense." In *Distributed Generation Law: A Guide to Regulations, Policies, and Programs,* edited by S. A. W. Fitts and F. K. Davis, 311–352. Chicago, IL: American Bar Association Book Publishing.

Rickerson, W., T. McDonald, M. Wu, C. Murray, and J. Graul. (2021, March 29). "The U.S. Department of Defense, Distributed Generation, and Energy Resilience." Chicago, IL: American Bar Association, Section of Environment, Energy, and Resources, Renewable, Alternative, and Distributed Energy Resources Committee.

Rickerson, W., M. Wu, and M. Pringle. (2018). "Beyond the Fence Line: Strengthening Military Capabilities Through Energy Resilience Partnerships." Washington, DC: Association of Defense Communities.

S.815—97th Congress (1981–1983): Department of Defense Authorization Act 1981. (1981, December 1).

Sanstad, A., Q. Zhu, B. Leibowicz, P. Larsen, and J. Eto. (2020, November). "Case Studies of the Economics Impacts of Power Interruptions and Damage to Electricity System Infrastructure from Extreme Events." Berkeley, CA: Lawrence Berkeley National Laboratory.

Sepulveda, L., and K. Smith. (2017, April 12–13). "GSA's Utility Regulatory Program: Regulatory Law and Utilities." Presented at Federal Utility Partnership Working Group 2017 Spring Seminar, Savannah, GA.

Starr, B., and E. Kaufman. (2021, February 18). "The US Military Helped Keep the Heat and Lights on for One Nebraska City as Temperatures Plummeted." CNN.com.

Stockton, P. (2014). "Resilience for Black Sky Days: Supplementing Reliability Metrics for Extraordinary and Hazardous Events." Washington, DC: National Association of Regulatory Utility Commissioners.

Stockton, P. N., and J. P. Paczkowski. (2019). "Strengthening Mission Assurance Against Emerging Threats: Critical Gaps and Opportunities for Progress." Joint Forces Quarterly 95: 22–31.

TRC. (2020). "Hanscom Air Force Base & MIT Lincoln Laboratory Microgrid Feasibility Study." Boston, MA: Massachusetts Clean Energy Center.

Tucson Electric Power (TEP). (2020a). "2020 Integrated Resource Plan." Tucson, AZ.

———. (2020b). "Irvington-East-Loop Transmission Line Project." Tucson, AZ.

———. (2021). "Patriot Substation." Tucson, AZ.

U.S. Air Force. (2017). "Energy Flight Plan 2017–2036." Washington, DC.

U.S. Air Force, Office of Energy Assurance (OEA). (2020, February 18). "Anchorage Bowl Infrastructure Resilience Project Concepts." Washington, DC: U.S. Air Force.

U.S. Air Force, Offutt Air Force Base. (2021). "Offutt Reduces Power Grid Load to Help Community During Frigid Temps." Omaha, NE.

U.S. Army, Office of Energy Initiatives (OEI). (2019a). "Anniston Army Depot, Alabama Solar Energy Project Provides On-Site Generation for Potential Microgrid & Supply Diversity." Washington, DC.

———. (2019b). "Fort Rucker, Alabama Solar Energy Project Provides On-Site Generation for Potential Microgrid & Supply Diversity." Washington, DC.

U.S. Department of the Air Force. (2016). "Air Force Pamphlet 32-10144—Implementing Utilities at U.S. Air Force Installations." Washington, DC.

U.S. Department of the Army. (2005). "Department of the Army Analysis and Recommendations BRAC 2005." Washington, DC.

———. (2015). "Army Regulation 420-41—Acquisition and Sale of Utilities Services." Washington, DC.

U.S. Department of Defense (DoD). (1983). "Department of Defense Instruction 3030.2 Community Planning and Impact Assistance." Washington, DC.

———. (2006). "Department of Defense Directive 3030.01 Office of Economic Adjustment (OEA)." Washington, DC.

———. (2014). "Department of Defense Instruction 8510.01 Risk Management Framework (RMF) for DoD Information Technology (IT)." Washington, DC.

———. (2021a). "DOD Announces Installation Climate Exposure Assessments Plan Through the Defense Climate Assessment Tool." Washington, DC.

———. (2021b). "Grant Awards, Advanced Search." Washington, DC.

———. (2021c). "Initial DOD Advisory Committees Approved for Resumption of Operations." Washington, DC.

U.S. Department of Defense, Defense Science Board (DSB). (n.d.). "Task Forces." https://dsb.cto.mil/taskforces.htm

———. (2021). "Charter and Membership Balance Plan." Washington, DC.

U.S. Department of Defense, Deputy Secretary of Defense. (1998). "Department of Defense Reform Initiative Directive #49 - Privatizing Utility Systems." Washington, DC.

U.S. Department of Defense, Office of the Assistant Secretary of Defense for Environment and Energy Resilience (ASD(EI&E)). (2021). "DoD Installation Exposure to Climate Change at Home and Abroad." Washington, DC.

U.S. Department of Defense, Office of the Assistant Secretary of Defense for Homeland Defense and Global Security (ASD(HD&GS)). (2021). "Defense Critical Infrastructure Program Roles." Washington, DC.

U.S. Department of Defense, Office of the Assistant Secretary of Defense for Infrastructure (ASD(I)). (2018). "Base Structure Report FY 2018 Baseline." Washington, DC.

U.S. Department of Defense, Office of the Assistant Secretary of Defense for Sustainment (ASD(S)). (2016). "Installation Energy Plans." Washington, DC.

———. (2018). "Policy on Energy Savings Performance Contracts and Utility Energy Service Contracts." Washington, DC.

———. (2020a). "Annual Energy Management and Resilience Report (AEMRR) Fiscal Year 2019." Washington, DC.

———. (2020b). "Energy Resilience and Conservation Investment Program (ERCIP)." Washington, DC.

———. (2020c). "Fiscal Year 2021 Operational Energy Budget Certification Report." Washington, DC.

———. (2020d). "Fiscal Years 2022 and 2023 Energy Resilience and Conservation Investment Program Guidance." Washington, DC.

———. (2020e). "Guidance on the Use of Easements in Pursuing Energy Resilience." Washington, DC.

U.S. Department of Defense, Office of the Assistant Secretary of Defense for Sustainment (ASD(S)), and U.S. Department of Energy, Assistant Secretary for the Office of Electricity (DOE/OE). (2020). "Memorandum of Understanding between DoD and DOE." Washington, DC.

U.S. Department of Defense, Office of the Assistant Secretary of Defense for Sustainment for Production and Logistics (ASD(SP&L)). (1992). "Defense Energy Program Policy Memorandum (DEPPM) 92-1 - Department of Defense Energy Security Policy." Washington, DC.

U.S. Department of Defense, Office of the Chief Management Officer. (2016). "DoD Instruction 5025.01—DoD Issuances Program" (Change 3 Effective May 22, 2019). Washington, DC.

U.S. Department of Defense, Office of Local Defense Community Cooperation (OLDCC). (2019). "Defense Spending by State—Fiscal Year 2019." Washington, DC.

———. (2020). "DCIP Proposal Results for Release—Final." Washington, DC.

———. (2021). "OLDCC Homepage." Washington, DC.

U.S. Department of Defense, Office of the Secretary of Defense (OSD). (2021a). "DOD Advisory Committees- Zero Based Review." Washington, DC.

———. (2021b). "DOD Dictionary of Military and Associated Terms." Washington, DC.

U.S. Department of Defense, Office of the Under Secretary of Defense for Acquisition and Sustainment (USD(A&S)). (2018). "Department of Defense Directive 5410.12 - Economics Adjustment Assistance to Defense-Impacted Communities." Washington, DC.

———. (2019). "Report on Effects of a Changing Climate to the Department of Defense." Washington, DC.

U.S. Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)). (2018). "Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report." Washington, DC.

U.S. Department of Defense, Office of the Under Secretary of Defense for Intelligence and Security (USD(I&S)). (2014). "Department of Defense Directive 5143.01 - Under Secretary of Intelligence and Security (USD(I&S))." Washington, DC.

———. (2016). "Department of Defense Instruction 5200.01 - DoD Information Security Program and Protection of Sensitive Compartmented Information (SCI)." Washington, DC.

U.S. Department of Defense, Office of the Under Secretary of Defense for Policy (USD(P)). (2018). "Department of Defense Directive 3020.40—Mission Assurance (MA)." Washington, DC.

U.S. Department of Defense, Office of the Under Secretary of Defense for Research and Engineering (USD(R&E)). (2019). "Terms of Reference - Defense Science Board Task Force on Department of Defense Dependencies on Critical Infrastructure." Washington, DC.

U.S. Department of Energy (DOE). (2020a). "FY 2021 Congressional Budget Request Volume 3 Part 1." Washington, DC.

———. (2020b). "Prohibition Order Security Critical Defense Facilities." *Federal Register* 86(3): 533–536.

———. (2020c). "U.S. Department of Energy, U.S. Department of Homeland Security, and U.S. Department of Defense Announce Pathfinder Initiative to Protect U.S. Energy Critical Infrastructure." Washington, DC.

———. (2021). "Revocation of Prohibition Order Securing Critical Defense Facilities." *Federal Register* 86(76): 21308–21309.

U.S. Department of Energy, Electricity Advisory Committee (EAC). (n.d.). "EAC Mission." Washington, DC: U.S. Department of Energy, Office of Electricity.

———. (2020). "Grid Resilience for National Security Scope." Washington, DC: U.S. Department of Energy, Office of Electricity.

U.S. Department of Energy, Office of Electricity (DOE/OE). (2018). "Grid Security Emergency Orders: Procedures for Issuance." Washington, DC.

———. (2020a). "Department of Energy's Electricity Advisory Committee Establishes the Grid Resilience for National Security Subcommittee." Washington, DC.

———. (2020b). "Supporting Energy Resilience at the Port of Alaska." Washington, DC.

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (DOE/EERE). (n.d.). "Federal and Utility Collaboration." Washington, DC.

———. (2021). "Utility Energy Service Contract Boosts Chemical Weapons Destruction Mission at Army Pueblo Chemical Depot." Washington, DC.

U.S. Department of the Navy. (2020). "Installation Energy Resilience Strategy." Washington, DC.

U.S. Department of the Navy, Naval Facilities Engineering Command (NAVFAC). (2016). "Lease Up to 181 Acres of Land for Renewable Energy, Resiliency, Reliability and Security at Pacific Missile Range Facility (PMRF) Barking Sands, Kauai, Hawaii" (Request For Proposals No. LO-2016294). Washington, DC.

U.S. Federal Emergency Management Agency (FEMA). (2016). "Benefit-Cost Sustainment and Enhancements: Baseline Standard Economic Value Methodology Report." Washington, DC.

U.S. Federal Highway Administration. (2021). "Defense Access Road Program (DAR)." Washington, DC.

U.S. General Services Administration (GSA). (n.d.). "Energy & Water Conservation, For Federal Agency Customers." Washington, DC.

U.S. Government Accountability Office (GAO). (2019). "Critical Infrastructure Protection: Actions Needed to Address Significant Cybersecurity Risks Facing the Electric Grid" (GAO-19-332). Washington, DC.

———. (2020a) "Climate Resilience: DOD Coordinates with Communities, but Needs to Assess the Performance of Related Grant Programs" (GAO-21-46). Washington, DC.

———. (2020b). "DoD Utilities Privatization: Improved Data Collection and Lessons Learned Archive Could Help Reduce Time to Award Contracts" (GAO-20-104). Washington, DC.

———. (2021). "Military Installations: DOD Should Consider Support Services When Designating Sites as Remote or Isolated" (GAO-21-276). Washington, DC.

U.S. Marine Corps. (2013). "Installation Energy Strategy." Washington, DC.

U.S. Office of the Director of National Intelligence (DNI). (2021). "Annual Threat Assessment of the U.S. Intelligence Community." Washington, DC.

U.S. Secretary of the Air Force. (2020). "Air Force Policy Directive 90-17—Energy and Water Management." Washington, DC.

U.S. Secretary of the Army. (2020). "Army Directive 2020–03—Installation Energy and Water Resilience Policy." Washington, DC.

Utility Privatization Partners. (n.d.). "About UPP." Washington, DC.

Wamsley, L. (2019, April 19). "Hurricane Michael Was A Category 5, NOAA Finds—The First Since Andrew in 1992." NPR.

Whitmer, G. (2019). "Request of Statewide Review of Supply and Deliverability of Natural Gas, Electricity and Propane and Contingency Planning." Lansing, MI: State of Michigan Office of the Governor.

———. (2020). "Executive Directive 2020-10: Building a Carbon-Neutral Michigan." Lansing, MI: State of Michigan Office of the Governor.

Yurack, J. (2013). "Defense Support of Civil Authorities During Hurricane Sandy." Washington, DC: U.S. Marine Corps.

Zitelman, K., and J. McAdams. (2021). "The Role of State Regulators in a Just and Reasonable Energy Transition: Examining Regulatory Approaches to the Economic Impacts of Coal Retirements." Washington, DC: National Association of Regulatory Utility Commissioners.

Appendix A. Defense Critical Infrastructure Policy Background

A number of policies inform current practices surrounding defense critical infrastructure (DCI).

- *Homeland Security Presidential Directive-7:* Critical Infrastructure Identification, Prioritization, and Protection. This Directive assigns responsibility to the DoD as a federal department. The responsibilities of the DoD include identification, prioritization, assessment, remediation, and protection of DCI. DoD is also identified as a sector-specific agency (SSA) for the Defense Industrial Base. Specifically, as the SSA, DoD's responsibilities include 1) supporting the identification, prioritization, and coordination to protect critical infrastructure and key resources and 2) facilitate sharing of information about physical and cyber threats, vulnerabilities, incidents, potential protective measures, and best practices (ASD(HD&GS).
- *Presidential Policy Directive (PPD-21):* Critical Infrastructure Security and Resilience (February 2013). PPD-21 establishes a national policy and approach on critical infrastructure security. It identifies the roles and responsibilities for government agencies, specifically the DHS, DoD, and DOE to strengthen and maintain a secure, resilient, and functioning critical infrastructure.
- *Joint Publication 3-27 Homeland Defense.* DCI was introduced in Joint Publication 3-27 on April 10, 2018, and is defined in the "DoD Dictionary of Military and Associated Terms" (January 2021) as "Department of Defense and non-Department of Defense networked assets and facilities essential to project, support, and sustain military forces and operations worldwide" (OSD, 2021a).
- *DoD Directive 3020.40 Mission Assurance.* This Directive designates responsibilities assigned in PPD-21 for the execution of critical infrastructure roles (USD(P), 2018). It also maintains a DCI line of effort to sustain programming, resources, functions, and activities to meet the national and DCI requirements established by PPD-21. PPD-21 assigns the Under Secretary of Defense for Policy (USD(P)) the responsibilities to coordinate DCI with DHS for inclusion in the defense critical asset list. USD(P) maintains the Defense Critical Infrastructure Program (OLDCC, 2020).

Appendix B. Commissions that Regulate Cooperative Utilities

State	Name of PUC
Arizona	Arizona Corporation Commission
Arkansas	Arkansas Public Service Commission
Hawaii	Hawaii Public Utilities Commission
Kentucky	Kentucky Public Service Commission
Louisiana	Louisiana Public Service Commission
Maine	Maine Public Utilities Commission
Maryland	Maryland Public Service Commission
Michigan	Michigan Public Service Commission
Nebraska	Nebraska Power Review Board
New Hampshire	New Hampshire Public Utilities Commission
New Mexico	New Mexico Public Regulation Commission
Utah	Utah Public Service Commission
Vermont	Vermont Public Utility Commission
Vermont	Vermont Department of Public Service
Virginia	Virginia State Corporation Commission

Glossary of Terms

Term	Definition
Critical Defense Facilities (CDF)	*"...the Secretary, in consultation with other appropriate Federal agencies and appropriate owners, users, or operators of infrastructure that may be defense critical electric infrastructure, shall identify and designate facilities located in the 48 continuous States and the District of Columbia that are—* *1) critical to the defense of the United States; and* *2) vulnerable to a disruption of the supply of electric energy provided to such a facility by an external provider." (H.R.22, 2015)*
Critical Electric Infrastructure (CEI)	*"The term **'critical electric infrastructure'** means a system or asset of the bulk-power system, whether physical or virtual, the incapacity or destruction of which would negatively affect national security, economic security, public health or safety, or any combination of such matters."*
Critical Electric Infrastructure Information (CEII)	*"The term **'critical electric infrastructure information'** means information related to critical electric infrastructure, or proposed critical electrical infrastructure, generated by or provided to the Commission or other Federal agency, other than classified national security information, that is designated as critical electric infrastructure information by the Commission or the Secretary."*
Critical Infrastructure Information	*"The term **'critical infrastructure information'** means information not customarily in the public domain and related to the security of critical infrastructure or protected systems—* *(A) actual, potential, or threatened interference with, attack on, compromise of, or incapacitation of critical infrastructure or protected systems by either physical or computer-based attack or other similar conduct (including the misuse of or unauthorized access to all types of communications and data transmission systems) that violates Federal, State, or local law, harms interstate commerce of the United States, or threatens public health or safety;* *(B) the ability of any critical infrastructure or protected system to resist such interference, compromise, or incapacitation, including any planned or past assessment, projection, or estimate of the vulnerability of critical infrastructure or a protected system, including security testing, risk evaluation thereto, risk management planning, or risk audit; or* *(C) any planned or past operational problem or solution regarding critical infrastructure or protected systems, including repair, recovery, reconstruction, insurance, or continuity, to the extent it is related to such interference, compromise, or incapacitation." 6 U.S.C. § 651-674*

continued

Term	Definition
Critical Infrastructure Protection (CIP)	*"Critical Infrastructure Protection (CIP) consists of actions taken to prevent, remediate, or mitigate the risks resulting from vulnerabilities of critical infrastructure assets. Depending on the risk, these actions could include changes in tactics, techniques, or procedures; adding redundancy; selection of another asset; isolation or hardening; guarding, etc." (H.R.22, 2015)*
Defense Critical Infrastructure (DCI)	*"Department of Defense and non-Department of Defense networked assets and facilities essential to project, support, and sustain military forces and operations worldwide. Also called DCI." (H.R.22, 2015)*
Defense Critical Electric Infrastructure (DCEI)	*"The term **'defense critical electric infrastructure'** means any electric infrastructure located in any of the 48 contiguous States or the District of Columbia that serves a facility designated by the Secretary ... but is not owned or operated by the owner or operator of such facility."(H.R.22, 2015).*
Defense Industrial Base	*"The Department of Defense, government, and private sector worldwide industrial complex with capabilities to perform research and development and design, produce, and maintain military weapon systems, subsystems, components, or parts to meet military requirements."*
Grid Security Emergency • •	*"The term **'grid security emergency'** means the occurrence or imminent danger of—a malicious act using electronic communication or an electromagnetic pulse, or a geomagnetic storm event that could disrupt the operation of those electronic devices or communications networks that are essential to the reliability of critical electric infrastructure or of defense critical electric infrastructure; and disruption of the operation of such devices or networks, with significant adverse effects on the reliability of CEI or DCEI, as a result of such act or event; or* *A direct physical attack on CEI or of DCEI; and* *Significant adverse effects on the reliability of CEI or of DCEI as a result of such physical attack." (H.R.22, 2015)*

NARUC
National Association of Regulatory Utility Commissioners

1101 Vermont Ave, NW • Suite 200 • Washington, DC 20005
www.naruc.org • (202) 898-2200