ILW SPOTLIGHT 18-3

Energy Resilience: An Imperative for a More Lethal, Agile and Strategically-Relevant Force

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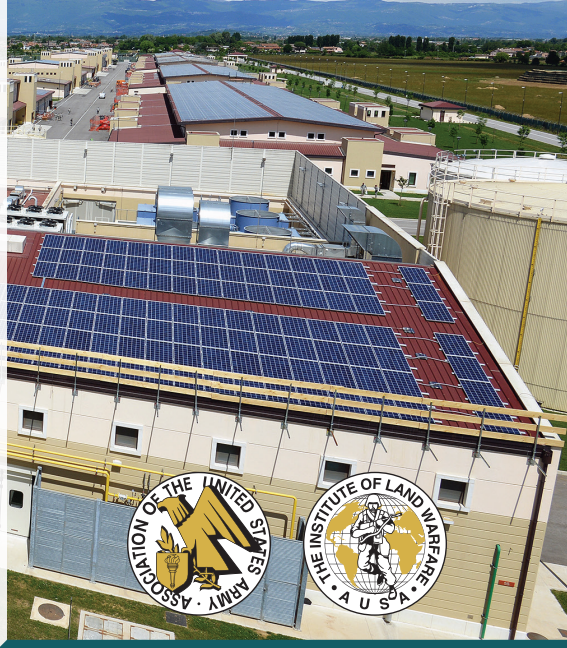

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It is increasingly clear that continental United States (CONUS)-based installations no longer provide sanctuary to U.S. military forces prior to their deployment. The global reach of hostile powers with cyber, space and physical capabilities can contest friendly rear areas as well as forward deployed forces.[1]

The expanding battlespace includes CONUS-based command posts, critical supercomputing operations, intelligence, fusion and cyber assets used by a global force and the joint logistics and sustainment functions required to support multi-domain operations—all of which emanate from installations in the Strategic Support Area (SSA).[2] **From an energy perspective, this blurs the distinction between installation energy and operational energy, suggesting that approaches to energy security at the tactical edge may be relevant to installations within the SSA.**

Modernizing how the Department of Defense (DoD) generates, manages and consumes power impacts how the Army sustains operations from its installations and facilities in CONUS to the forward edge of distant battlefields. The U.S. Army—and the rest of DoD—needs to maintain focus on the issue of energy resilience to be a ready, lethal and modernized force.[3]

Strategic Context: The Shifting Character of War

The 2017 U.S. National Security Strategy (NSS) describes a world in which many actors have become "skilled at operating below the threshold of military conflict" and highlights vulnerabilities in U.S. critical infrastructure such as the electrical grid.[4] The NSS states that America must "strengthen

[1] Department of the Army, Army Field Manual (FM) 3-0, Operations (Washington, DC: Headquarters, Department of the Army, 6 October 2017), p. 1-9; Colonel Patrick M. Duggan, Spotlight 18-1, *Modernization for Industrial Age U.S. Army Installations*, AUSA's Institute of Land Warfare, February 2018.

[2] Jack Surash, "Multi-Domain Battle: Challenges for Army Energy," ASA IE&E presentation, 30 January 2018.

[3] Department of the Army, *U.S. Army Energy Security & Sustainability Strategy* (Washington, DC: Headquarters, Department of the Army, 2016).

[4] The White House, *National Security Strategy of the United States of America*, December 2017, pp. 3, 12, http://nssarchive.us/wp-content/uploads/2017/12/2017.pdf.

ISSUE

The U.S. Army needs to maintain focus on energy resilience—from factory to fort to foxhole—to be a more lethal, agile and strategically-relevant force.

SPOTLIGHT SCOPE

- Addresses strategic support area (SSA) vulnerabilities described in FM 3-0, *Operations and Multi-Domain Operations: Evolution of Combined Arms for the 21st Century*.
- Incorporates Army Warfighting Challenges:
  - conduct homeland operations;
  - conduct joint expeditionary maneuver and entry operations; and
  - set the theater, sustain operations and maintain freedom of movement.
- Highlights continuum between installation and operational energy.

IMPLICATIONS

- Energy resilience is integral to Army readiness, modernization and reform;
- energy resilience is foundational to leveraging emerging capabilities across a continuum—home station training, mobilization, deployment and operational employment;
- the Army has begun to reevaluate how it delivers power to the battlefield and how to increase SSA resilience; and
- public-private partnerships and interdisciplinary education are essential to achieving energy resilience.

its capabilities across numerous domains—including space and cyber—and revitalize capabilities that have been neglected." It also calls for the United States to become an energy-dominant nation with energy initiatives that attract investment, safeguard the environment and strengthen security.[5]

The complementary 2018 National Defense Strategy (NDS) underscores that "**the homeland is no longer a sanctuary**."[6] The NDS calls upon DoD to "anticipate the implications of new technologies on the battlefield, rigorously define the military problems anticipated in future conflict, and foster a culture of experimentation and calculated risk-taking."[7]

The evolving strategic context is driving what U.S. Army Chief of Staff, General Mark Milley, describes as an emerging "fundamental change in the character of war." Technology, geopolitics and demographics are rapidly changing societies, economies and the tools of warfare, affecting why, how and where wars are fought—and who will fight them.

Milley sees that these shifts not only present challenges, but opportunities as well. "If we can anticipate or at least recognize [the shifts], we can adapt proactively, maintaining or regaining overmatch and forcing competitors to react to us. Missing these shifts, however, can have devastating consequences."[8] **The U.S. Army recognizes that these shifts are occurring not only on distant battlefields, but also at home.**

The new Weed Army Community Hospital, as seen in this June 2017 photo, is DoD's first Leadership in Energy and Environmental Design (LEED)-Platinum, carbon-neutral medical facility built in the United States. It generates all of the energy it needs by solar power and other renewable energy systems. It is one of three LEED-Platinum medical facilities built in the United States, but the only one built for DoD (Photo by Brooks Hubbard/USACE).

Insights from Operational Energy

Based on lessons from rapid prototyping and fielding of operational energy systems by the Army's Rapid Equipping Force, the Army has begun to reevaluate the way it delivers power to the battlefield.[9] Because fuel and energy are essential to operational and tactical effectiveness, the Army has spearheaded the field-testing of advanced power systems in support of deployed forces in Afghanistan, Africa and Central America.

Advanced power systems align supply with demand, using power available from grids, vehicles, generators and renewables to supply only the power necessary at the point of need. If a power source is disabled, other sources pick up the deficit and batteries balance the load. These systems combine mobility with renewable energy, battery storage and legacy systems (e.g.,

"Soldier readiness starts at home on top quality Army installations."

–General Mark A. Milley

SECRETARY OF DEFENSE PRIORITIES FOR THE JOINT FORCE

- **Build a more lethal force**;
- strengthen alliances and attract new partners; and
- reform the department for greater performance and affordability.

[5] *Ibid*., p. 22.

[6] Department of Defense, *Summary of the 2018 National Defense Strategy of The United States of America: Sharpening the American Military's Competitive Edge*, 19 January 2018, p. 3, https://www.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.

[7] *Ibid*., p. 7.

[8] Mark A Milley, "Chief of Staff of the Army: Changing Nature of War Won't Change Our Purpose," *AUSA Headline News*, 1 October 2016, https://www.ausa.org/articles/changing-nature-war-wont-change-our-purpose.

[9] Department of Defense, *2016 Operational Energy Strategy*, p. 6, https://www.acq.osd.mil/eie/Downloads/OE/2016%20DoD%20Operational%20Energy%20Strategy%20WEBc.pdf.

vehicle charging and commercial and advanced mobile medium power source generators) to compensate for deficits in available power.

At the tactical edge, energy resilience is also being enhanced by multiple efforts, including:

- reduced demand through increased efficiency;
- multiple power generation sources, optimized for system outcomes;
- energy storage devices;
- intelligent, secure grids able to move power to key loads; and
- enhanced training.

These initiatives—resulting from the Army rethinking how it delivers power to the battlefield—offer insights to the situation facing CONUS installations and power projection platforms.

Chief Warrant Officer 3 Cipriano Trujillo, U.S. Army Central Forward Engineering Directorate, sets up the first of 250 solar light towers on 2 October 2015 at Camp Arifjan, Kuwait. The solar lights replaced gas-powered light towers at Camp Arifjan and are part of a larger initiative to conserve energy in the USARCENT area of responsibility (U.S. Army photo by Sergeant James J. Bunn/USARCENT).

From Factory to Fort to Foxhole—Installation Readiness is Operational Readiness

Installations serve as the initial maneuver platforms for projecting forces into a given theater and, once employed, for conducting operations. These installations—Strategic Readiness Platforms—consist of power projection, force mobilization capabilities and the critical infrastructure needed to:

- train, mobilize and deploy forces;
- project multi-domain capabilities; and
- provide materiel support for Combatant Command operations plans or contingency requirements to meet the NDS.[10]

"Warfighter readiness begins on Army installations, and, like it or not, Army installations are now part of the fight. Army doctrine, policies, and resourcing decisions will need to prepare to meet these challenges."[11] This is critical because the Army must be able to operate with diverse partners to defend the homeland and mitigate the effects of attacks and disasters. It must deploy and project forces, conduct forcible and early entry and set conditions across multiple domains to rapidly transition to offensive operations to ensure access and seize the initiative. The Army must also set the theater, provide strategic agility to the joint force and maintain freedom of movement and action during sustained and high-tempo operations while at the end of extended lines of communication in austere environments.[12]

Installation energy security and resilience is foundational to ensuring the availability of operational energy for force generation and power

The Army has begun to reevaluate the way it delivers power to the battlefield.

TERMS OF REFERENCE

- **Operational Energy**: The energy and associated systems, information and processes required to train, move and sustain forces and systems for military operations.
- **Installation Energy**: The traditional energy sources used to heat, cool and provide electrical power to barracks, commissaries, data centers, office buildings, laboratories and maintenance facilities.
- **Resilience**: The ability to anticipate, prepare for and adapt to changing conditions and withstand, respond to and recover rapidly from disruptions.

[10] Kristine Kingery, Director Installation Energy Security and Sustainability ODASA (E&S), Federal Utility Partnership Working Group (FUPWG), Fall 2017.

[11] Richard G. Kidd IV, "Threats to Posts: Army Must Rethink Base Security," *AUSA Headline News*, 21 December 2017, https://www.ausa.org/articles/threats-posts-army-must-rethink-base-security.

[12] Army Capabilities Integration Center, "Army Warfighting Challenges," http://www.arcic.army.mil/initiatives/armywarfightingchallenges, accessed 14 March 2018.

projection.[13] As such, the Army is reinforcing DoD efforts to make energy resilience a foundational requirement. From modernization of its domestic power footprint in conjunction with local communities, pursuit of promising energy technology and enhancing agility and resilience of power projection and deployed forces, the Army is integrating new capabilities and changing business practices.

Although not directly articulated in the Army Warfighting Challenges (AWFCs), energy resilience is essential to addressing several Army capability gaps. These AWFCs include: **conducting homeland operations; conducting joint expeditionary maneuver and entry operations; and setting the theater, sustaining operations and maintaining freedom of movement.**

A.J. Ballard, the energy manager for the Maine Army National Guard, points out some of the engine details of the award-winning combined heat and power system at the Maine Army National Guard Army Aviation Support Facility in Bangor, Maine. "This is a wonderful machine," said Ballard. "This system produces electricity we don't have to pay for, and heat we don't have to pay for" (U.S. Army photo by Staff Sergeant Angela Parady, 121st Public Affairs Detachment).

DoD Reliance on Commercial Power

Among the vulnerabilities to the SSA is the dependence of many DoD installations upon the private sector and surrounding communities for commercial power. Cascading effects of power disruption, extending to communications and water infrastructure, have the potential to inhibit the ability to project power, conduct operations in the SSA and support forward deployed forces.

The vulnerabilities of power sources beyond the installation are significant. Most of the power moving throughout the various utilities that operate the U.S. grid is sourced through a handful of critical points in the transmission and distribution system. A January 2017 U.S. Department of Energy report to Congress assessed that:

> DoD's reliance on commercial power presents many of the same challenges faced by all electricity customers: the transmission system is highly-vulnerable to weather-related damage, natural disasters such as earthquakes and physical attacks; electricity substations are vulnerable to cyber and physical attacks, as well as to geomagnetic storms; the distribution system is highly-vulnerable to weather and natural disasters; and controls centers are vulnerable to cyber and physical attacks.[14]

RELATED AWFCs:

- conduct homeland operations;
- conduct joint expeditionary maneuver and entry operations; and
- set the theater, sustain operations and maintain freedom of movement.

TRANSMISSION SYSTEM AND CONTROL CENTER VULNERABILITIES:

- weather-related damage, geomagnetic storms;
- natural disasters such as earthquakes;
- physical attacks; and
- cyber attacks.

The Way Forward

Public-Private Partnerships

The Army has introduced diverse power production sources to more than a dozen CONUS-based installations. (Most utility scale renewable energy generation is "grid-tied," meaning that if the grid distribution or transmission systems are disrupted, alternative power sources will not work unless designed for off-grid or islanded capability.) For example, in May 2018, the Army began operations of a 50-megawatt, multifuel power plant at

[13] Surash, "Multi-Domain Battle: Challenges for Army Energy."

[14] U.S. Department of Energy, "Valuation of Energy Security for the United States," Report to Congress, January 2017, https://www.energy.gov/sites/prod/files/2017/01/f34/Valuation%20of%20Energy%20Security%20for%20the%20United%20States%20%28Full%20Report%29_1.pdf.

Schofield Barracks, Hawaii. The first of its kind on any Army installation, the Army provided the land upon which Hawaiian Electric Co. built the plant and will run it for the Army. In the event of a prolonged disruption, the base, plus Wheeler Army Airfield and the local hospital, will be able to continue operating off the grid for 30 days.[15]

In 2015, Fort Drum also tested the off-grid concept, disconnecting from the national grid and powering all installation operations from a biomass plant. This demonstration of resilience and self-sufficiency was an important step toward installation modernization for the emerging operational environment.

Acting Assistant Secretary of the Army for Installations, Energy and the Environment Jordan Gillis listens to Hawaiian Electric Co. Manager of Generation Project Development Jack Shriver on 19 January 2018 during a tour of the Schofield Barracks Generating Station (U.S. Army photo by Karen A. Iwamoto, Oahu Publications).

Energy Resilience: A Critical Enabler for Readiness and Modernization

The U.S. Army has embarked on its most significant modernization campaign since the "Big Five" acquisitions of the 1970s that were informed by insights from the 1973 Yom Kippur War and the build-up of Warsaw Pact forces in Western Europe. The Army modernization plan announced in October 2017 is informed by lessons from the Russian invasion of Ukraine in 2014 and has led to the establishment of U.S. Army Futures Command to provide a focus on its top priorities.

The modernized systems under development will require uninterrupted, resilient advanced power from home station to the battlefield at all echelons. Science and technology investment in the right concepts is necessary for effective modernization. Increased command, control, communications, computer, intelligence, surveillance and reconnaissance capabilities and enhanced movement and maneuver require power and energy as critical enablers. The Army needs to account for power and energy as part of the development of new capabilities to preclude unforeseen sustainment issues that may impact force effectiveness for decades.[16]

Increasing Installation Readiness and Resilience

Prolonged budget constraints have adversely affected installation readiness and resilience. For the Army to train as it will fight, and become a more ready and lethal force, energy resilient installations are essential. Therefore, the Army needs a value equation for resiliency efforts that enables key projects to effectively compete for resources and private financing mechanisms.

The emerging challenges of the operating environment necessitate investments in resiliency initiatives including vehicle-to-grid and tactical microgrids, while enhancing and leveraging talents which can utilize agile acquisition methods that assign value to resiliency efforts.

The DoD Operational Energy Strategy emphasizes that training should reflect the reality of the increased risks to U.S.-based operations. It also

ARMY MODERNIZATION PRIORITIES

- long-range precision fires;
- next generation combat vehicle;
- future vertical lift;
- network:
  - network command, control, communication and intelligence
  - assured positioning, navigation and timing;
- air and missile defense; and
- soldier lethality:
  - soldier lethality
  - synthetic training environment.

[15] "Smart Technology Coming to Army Posts," *AUSA Headline News*, 13 June 2018, https://www.ausa.org/news/smart-technology-coming-army-posts.

[16] "Power and Energy Enabling Multi-Domain Battle," Presentation by U.S. Army Communications, Electronics Research, Development and Engineering Center Power Division, 31 January 2018.

stresses that war-gaming, modeling and simulation tools, along with focused analyses, should be exercised jointly when enhancing readiness at home.[17]

Potential adversaries have ready access to technologies and techniques that allow them to delay mobilization, disrupt deployments, interfere with operations, undermine morale and create friction between installations and surrounding communities. Army doctrine, policies and resourcing decisions should prepare to meet these challenges.[18]

Advanced functionalities that can come from tactical microgrids and vehicle-to-grid (VTG) efforts can support deployed combat forces, humanitarian assistance and disaster relief efforts, cooperative security engagements and CONUS training.[19] Envisioned future capabilities include on-demand microgrids that use a combination of platforms including ground generators and tactical vehicles as well as the ability for grid segmentation and silent watch.[20] **Both in CONUS and deployed overseas, tactical microgrids can relieve pressure on the national grid in a crisis**.

Arecibo, Puerto Rico – The U.S. Army Corps of Engineers Task Force Power Restoration assists with the installation of a microgrid in Arecibo, Puerto Rico, 30 January 2018. Potentially 250 households and infrastructure in Arecibo will be powered once the microgrid is activated. The USACE installed seven active microgrids around the island (Photo by Robert DeDeaux/USACE Public Affairs).

To address these challenges, it is necessary to leverage expertise in academia as well as in the commercial and financial sectors. These are not just engineering challenges—they require strategic collaboration with installation management, training and doctrine, policy and acquisition, logistics and sustainment as well as the financial and project development communities.

Enhanced use of rapid and agile acquisition models—adaptable for evolving concept of operations—are foundational to meeting modern energy challenges. Being fixated solely on the requirement limits the ability to rapidly adjust to new realities. Adopting rapid acquisition models not only saves time and tax-payer dollars, but often delivers superior capabilities.

Tactical microgrids: a flexible and mobile group of interconnected sources and loads that act as one controllable entity organized as a system. It is self-contained, readily deployable and can use alternative and renewable energy production and storage.

Vehicle-to-grid: a tactical vehicle and alternative power initiative to increase use of alternative energy to reduce petroleum consumption and emissions. VTG capabilities include importing and exporting grid power or islanded power to installations using vehicles to move energy, store energy and distribute power on demand—at the point of need. This is foundational to the Army's expeditionary energy strategy.

Recommendations

- Enhance efforts to articulate the contribution of energy resilience to the military value of installations, their critical infrastructure and lethality of the force.
- Develop a continuous power mindset, extending from modernization and development to CONUS installations to deployed forces—across all echelons.
- Assign a cost-value equation to resilience-hardening.
- Rehearse contingencies pertaining to attacks on critical infrastructure in the strategic support area.

[17] *2016 Operational Energy Strategy*, p. 14.

[18] Kidd, "Threats to Posts: Army Must Rethink Base Security."

[19] Tactical Microgrid Standards Consortium, "Emerging Interoperability Standardization of Tactical Microgrids," 25 January 2017.

[20] *Ibid*., p.7.

- Fund integrated advanced power solutions such as VTG and tactical microgrids, enabled by talent development and the use of agile and rapid acquisition methods.
- Pursue collaboration with industry and academia in support of a national energy security strategy.

Conclusion

A resilient energy infrastructure enterprise can provide assured access to critical power for the installations where Soldiers train, from which they mobilize and deploy, and wherever they are employed in pursuit of national military objectives. This will be essential to DoD's realization of its top priorities of increasing readiness and lethality.

The U.S. Army—and DoD—must increase focus on energy resilience to remain operationally relevant in the emerging threat environment. Without this foundational critical enabler, it risks the accomplishment of its mission, both domestically and overseas.

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A U.S. Army CH-47 Chinook helicopter prepares to unload two 500 gallon fuel blivets during a sling load training exercise at Bagram Airfield in Parwan province, Afghanistan, 30 July 2013 (U.S. Army photo by Spcialist Ryan Green).

ENHANCING HUMAN CAPITAL: CENTER FOR GLOBAL RESILIENCE AND SECURITY (CGRS)

- Norwich University, the nation's oldest military college and birthplace of ROTC, has trained generations of Army civil engineers.
- In Fiscal Year 2018, with funding from Congress, Norwich established CGRS to provide research and education on new power technologies for use in expeditionary operations and Army facilities alike.
- CGRS's goal is to educate toward a mindset focused on efficiency, optimization and smarter logistics in development of the Army's next generation of civil engineers.


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