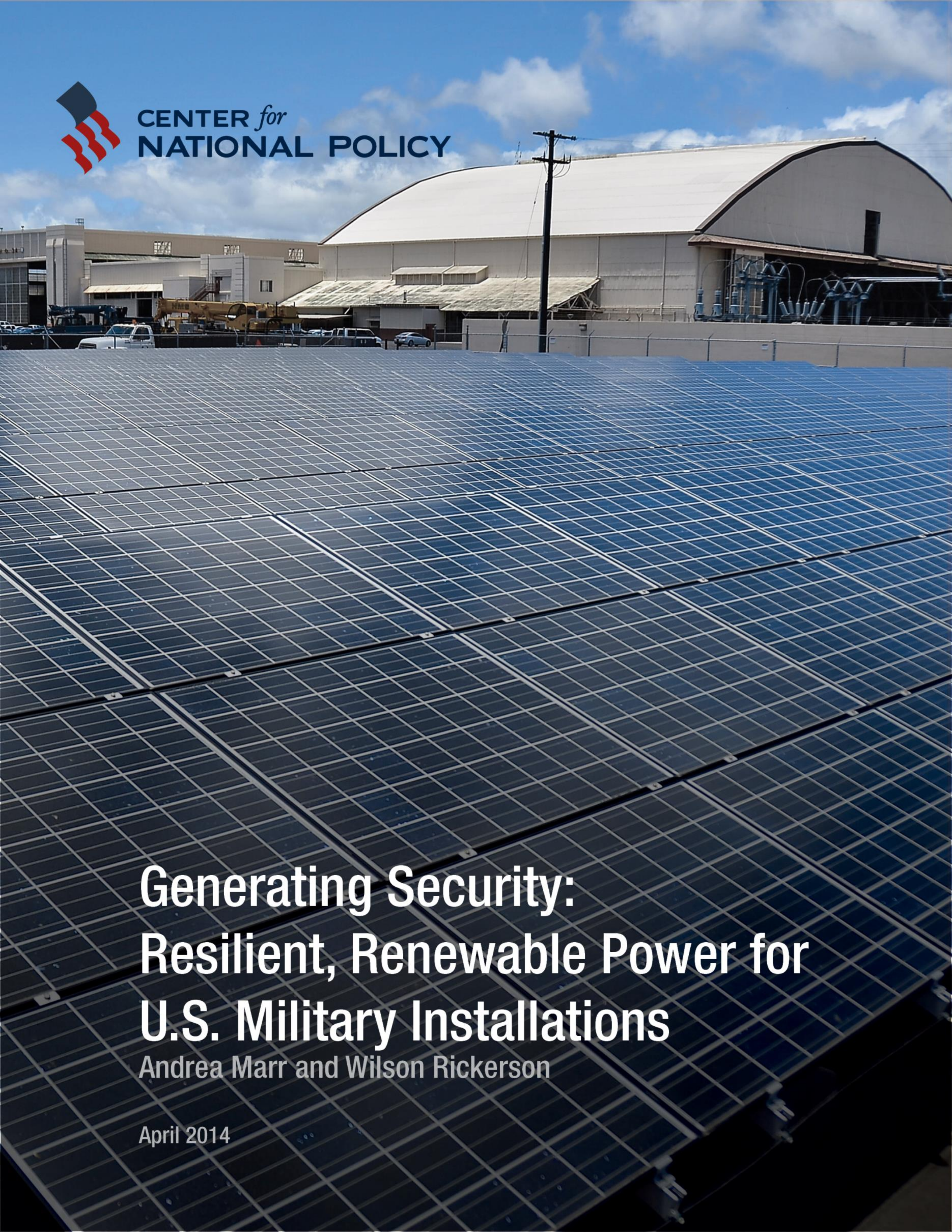

CENTER *for* NATIONAL POLICY

Generating Security: Resilient, Renewable Power for U.S. Military Installations

Andrea Marr and Wilson Rickerson

April 2014

ABOUT THE AUTHORS

Andrea Marr

Andrea Marr is an energy efficiency engineer for McKinstry Company, based in Irvine, CA. She develops utility reduction strategies for large institutions and facilities including the California Institute of Technology and Los Angeles Unified School District. Prior to joining McKinstry, Andrea worked for a small non-profit in Nicaragua, designing and installing wind turbines and solar panels in rural communities without access to the national electric grid. In 2005, she graduated from the United States Naval Academy with a degree in Aerospace Engineering and subsequently served as the Gunnery Officer on two deployments in support of Operation Iraqi Freedom and as a Nuclear Engineering Officer for a third deployment. She holds an M.S. in Engineering Management from Old Dominion University where her final coursework focused on the success and failures of the Leadership in Energy and Environmental Design (LEED) Green Building program.

Wilson Rickerson

Wilson Rickerson is the CEO of Meister Consultants Group (MCG), a consulting firm focusing on sustainable energy and climate resilience. Mr. Rickerson is an expert in renewable energy policy and has supported policy development in Africa, Asia, the Middle East, Latin America and the Caribbean, Europe, and North America. In the US, he has advised state governments, utilities, and industry organizations on policy development and strategy. At the local level, he has worked closely with Boston and New York on their renewable energy programs, and supports the US DOE's national solar cities initiatives. Internationally, he has partnered with Deutsche Bank, the Inter-American Development Bank, IEA-RETD, UNEP, UNDP, and other organizations on energy and climate initiatives. He is an expert with the Clean Energy Solutions Center, serves on the Editorial Board of BioCycle Magazine, and is a Truman National Security Fellow. He holds a Masters in Energy and Environmental Policy from the University of Delaware and a B.A. from the College of William and Mary.

The Center for National Policy is an independent policy institute, which brings together leaders from government, the private sector, and civil society to develop strong, smart and principled solutions to the global challenges Americans now face.

Founded in 1980 by a group of leaders that included three Secretaries of State and a future President, CNP is a 501(c)3 tax-exempt nonprofit organization. CNP does not take institutional positions on policy issues, and all views expressed in its publications should be understood to be solely those of the authors.

CNP is a partner of the Truman National Security Project, which unites next-generation veteran, political, and policy leaders to develop and advance strong, smart and principled solutions to the global challenges Americans now face.

EXECUTIVE SUMMARY

This paper explores opportunities for the U.S. military to use its renewable energy procurement to achieve energy security for its domestic facilities. Power outages caused by extreme weather and intentional attack pose a major risk to U.S. military bases. In order to maintain its missions abroad and support its expanding mission on U.S. soil, the Department of Defense (DoD) will need to deploy resilient energy systems that can sustain critical domestic operations during blackouts. All four military services have adopted renewable energy targets in response to federal legislation and Executive Orders and are installing on-base renewable energy. Renewable energy sources such as wind and solar can provide bases with an unlimited and local source of power during grid disruptions. Current procurement policies and practices, however, do not provide a clear model for integrating renewable energy and energy security. In order to scale-up the integration of renewable energy into back-up power systems and microgrids, the DoD should consider the following recommendations:

Support enhanced energy security planning. Each installation should determine the pathway to energy security on their individual facility. A ranking of facility criticality and energy back up requirements should be included as part of this master planning exercise, and renewable energy sources available to meet those needs should be identified.

Empower energy managers. Base energy managers are in the best position to support the scale-up of renewable energy configured to provide energy security. Providing energy managers with increased authority and funding will empower them to enact policies and changes that will better lay the groundwork for resilient installations. Revenues and cost savings from DoD energy investments, for example, cannot be captured and reinvested by bases. Enabling legislation to allow installations access to these funds could significantly support current and future installation energy security activities.

Create pathways to procure and fund energy security. DoD should develop guidance for bases to procure secure renewable energy systems in a replicable way. This could include the adoption of cost-benefit analyses that recognize the value of energy security and enable resilient renewable energy systems to be procured at a premium above the price of non-secure energy. DoD should also provide funds to support projects on DoD installations that improve facility energy security. This project could mirror the existing Energy Conservation Investment Program (ECIP).

Create community partnerships. Bases should identify opportunities to jointly pursue secure renewable energy with their local utilities and surrounding communities. There could be significant opportunities for new partnerships focusing on energy security, particularly given increasing interest in climate adaptation planning on the part of federal, state, and local governments and the reliance of DoD bases on state and local infrastructure.

"Cyber-attacks, EMP events, or natural disasters could cause long term and wide-spread disruptions to the electrical supply – How the nation prepares to combat these threats will dictate how effectively we will be able to respond to adversaries bent on the destruction of our way of life." – Hon. William C. Anderson, Former Assistant Secretary of the United States Air Force for Installations, Environment and Logistics (Anderson, 2014)

INTRODUCTION – FRAGILE GRID, FRAGILE DEFENSE

Most Americans take the electricity that powers their lives for granted. During the past several years, however, the electric grid's vulnerabilities and limitations have been brought into sharp relief. In 2012, Hurricane Sandy left 8.5 million without power in seventeen states and caused an estimated $14-$25 billion in damages (CEA & DOE 2013).[1] The number of major weather-related grid disruptions has trended upward from less than 20 in 2001 and 2002, to an average of more than 90 per year between 2008-12. A recent report from the GAO predicted that the impact of weather on the power system would likely become increasingly severe as the climate continues to be disrupted, stating that our 100-year old electric grid was "engineered and built for our past or current climate" – and not the climate of the near-future (GAO, 2014).

The grid is also vulnerable to intentional damage. An attack on a California electrical substation by an unknown group armed with semiautomatic weapons disabled 17 transformers in April 2013. John Wellinghoff, who was then Chairman of the Federal Energy Regulatory Commission (FERC), stated that: "It would not be that hard to bring down the entire region west of the Rockies if you…had a coordinated attack like this against a number of substations (Halper & Lifsher, 2014)." A coordinated attack could take months to recover from[2] and could create unprecedented economic and social challenges for the US (NRC, 2012). Electromagnetic pulse (EMP) attacks, which can cripple electronic systems on a large scale, also pose a distinct threat to our grid. The national commission on the threat of EMP attacks concluded in 2008 that, "No infrastructure other than electric power has the potential for nearly complete collapse in the event of a sufficiently robust EMP attack (Foster et al., 2008)." Addressing these threats to the power grid will require smart investments to both harden the grid's defense and make its clients more independent and resilient. A comprehensive security solution will also require robust relief and recovery strategies.

The United States military has played an increasing role in domestic response to natural disasters during the past several years and would play a critical role in the catastrophic attack scenarios described above. At the same time, the military's own domestic infrastructure is particularly vulnerable to power outages. The Department of Defense (DoD) owns 300,000 buildings around the country and is the single largest consumer of energy in the nation. In 2008, the Defense Science Board (DSB) concluded that the "[a]lmost complete dependence of military installations on a fragile and vulnerable commercial power grid and other critical national infrastructure places critical military and Homeland defense missions at an unacceptably high risk of extended disruption" (DSB, 2008). In response to this and other vulnerability assessments,[3] DoD has undertaken a series of initiatives to coordinate and improve on-base energy

In order to both maintain its missions abroad and support its expanding mission on U.S. soil, DoD will need to incorporate local and resilient energy systems. While DoD's energy planning has supported the purchase of large amounts of renewable energy, these procurements have not delivered commensurate benefits for onsite energy security.

security, such as the formation of the Energy Grid Security Executive Council and the demonstration of innovative critical power systems (Stockton, 2011; DoD, 2013). The fragility of the commercial power grid remains a challenge, however. In 2012, for example, DoD reported 87 outages of eight hours or more at its bases – of which 98% were attributed to acts of nature (e.g. storms and forest fires) (DoD, 2013).[4]

In order to both maintain its missions abroad and support its expanding mission on U.S. soil, DoD will need to incorporate local and resilient energy systems. While DoD's energy planning has supported the purchase of large amounts of renewable energy, these procurements have not delivered commensurate benefits for onsite energy security.[5] There is an opportunity for DoD to simultaneously support sustainable energy goals and energy security by procuring renewable energy configured to provide resilient onsite power.

RENEWABLE ENERGY PROCUREMENT AT DOD

DoD is currently playing a national leadership role in the procurement and installation of renewable energy in response to a series of federal laws and Executive Orders. These include:

- Energy Policy Act of 2005, which requires federal agencies to achieve 7.5% of facility electricity consumption from renewable sources in FY2013.
- Executive Order 13423 of 2007, which requires that half of the renewable resources procured to meet the 7.5% target be sourced from renewable generators built after 1999.
- National Defense Authorization Act (NDAA) of 2007, which requires the DoD specifically to procure or produce 25% of the electricity it consumes in its facilities and activities during FY2025.
- Executive Order 13514 of 2009, which sets a government-wide greenhouse gas emission reduction goal of 28% below 2008 levels by 2020.
- The Presidential Memorandum regarding Federal Leadership on Energy Management of December 2013, which directs that 20% of the energy consumed by each federal agency come from renewables by 2020.

All four military services have formally adopted targets in response to these mandates, and in most cases the military targets exceed the government-wide goals (Closson, 2013; DoD, 2012). DoD has also formally committed to focusing on local renewable energy development, rather than purchasing renewable energy from remote sources, and each of the military departments has committed to developing one gigawatt of renewable energy on or near their installations by FY 2025 (DoD, 2012, 2013). DoD bases have aggressively pursued the achievement of these targets. It is estimated that 384 megawatts (MW) of on-base renewable energy had been installed by 2013, with an additional 1.7 GW in the pipeline to be installed by the end of 2018 (Pew, 2014).

Despite this significant investment in renewable energy, these systems generally do not contribute to increased energy security on military installations. Most on-base renewable energy power systems are configured to offset electricity purchases from the grid but cannot provide power to the base during blackouts.

DoD facilities have long used diesel generators as a backup source of power. Driven by the Defense Critical Infrastructure Program, and other more recent efforts to prioritize the criticality of select on-base assets, diesel generators are increasingly installed to specifically back up essential loads. These systems, however, are susceptible to sustained blackouts because of limited fuel and the vulnerability of fuel delivery infrastructure to power disruption. Energy technologies that use inherently local and renewable fuels, such as wind, solar, biomass, and geothermal power, can provide the greatest degree of energy certainty to military installations and can stretch scarce fossil fuel supplies

Current DoD procurement pathways are not designed to accommodate projects that utilize renewable energy to deliver energy security. Historically, military bases have relied on a mix of budget appropriations and alternative financing mechanisms – such as energy service performance contracts (ESPCs) - to fund on-base energy infrastructure and to procure energy-related services.

Under ESPCs, energy service companies (ESCOs) finance and install energy conservation measures and then guarantee that the resulting cost savings will pay back the investment over time. DoD has used ESPCs and related contracting vehicles to award more than $6 billion in energy savings contracts since the 1990s, with more than $800 million awarded in FY2012 alone. Additional alternative procurement mechanisms include enhanced use leases and DoD's authority under 10 U.S. Code subsection 2922(a) to enter into 30-year power purchase agreements (PPA) with third-party power generators. The 2922(a) authority was unutilized until only recently (Koch, 2014). Several bases have now utilized it to enter into long-term PPAs with renewable generators and it is projected that 2922(a) authority will be utilized to procure a significant proportion of future DoD renewable energy as a result of budget decreases and sequester.

Although ESPCs and PPAs have been successful for installing on-base renewable energy and energy efficiency, they do not represent a scalable pathway for procuring energy security infrastructure. Developing and financing truly energy secure installations will require innovative new mechanisms for valuing and purchasing energy systems that are able to operate independent of the grid using locally-available and renewable fuels. These new procurement mechanisms will also need to be supported by new strategies for empowering base staff and for engaging local communities in joint resiliency planning.

CURRENT APPROACHES TO ENERGY SECURITY INNOVATION

Renewable energy can provide reliable and resilient energy in many different configurations, and different bases may benefit from different types of renewable energy security solutions. Resilient renewable energy applications can range from small stand-alone systems with battery back-up (e.g. solar-powered emergency lighting or remote communications stations) to large-scale microgrids. For larger bases with many critical buildings, microgrids may present opportunities for both operational efficiencies and cost savings compared to using unintegrated, building-specific generators (Van Broekhoven et al., 2012). A microgrid is an electrical system that can operate both in connection with the grid and completely independent of the grid (i.e. "islanding"), and that can provide power through distributed generation to multiple loads across a military installation. The focus on distributed generation within a microgrid is important; in most cases, generation is unlikely to occur at a single location. Whether power originates from solar panels spread across an installation or a gas connection from an adjacent landfill tied to a backup generator, the microgrid must be capable of integrating many sources into one cohesive power supply. As of 2012, there were 44 DoD installations working with microgrids, accounting for more than half of the microgrid projects in the United States (Pew, 2014).

Aside from the electrical engineering challenges associated with integrating multiple generators into a microgrid, a truly secure installation will also require advanced metering and automated building controls so that base grid operators can understand the current electrical load and tailor generation to meet it. In order to reduce the amount of generation required, buildings and building systems (e.g. hot water loops and air conditioning) would ideally be operated and maintained to be as efficient as possible.

Renewable energy can provide reliable and resilient energy in many different configurations, and different bases may benefit from different types of renewable energy security solutions. Resilient renewable energy applications can range from small stand-alone systems with battery back-up (e.g. solar-powered emergency lighting or remote communications stations) to large-scale microgrids.

For many installations, the combined challenges of procuring renewable energy, achieving and sustaining efficient operations, and integrating energy assets into a resilient local network are insurmountable without large capital investments. Even in more straightforward cases where distributed generation is used as a backup for specific critical loads, funding and utility regulations may pose significant challenges.

There are currently several DoD programs that attempt to identify these challenges and provide a platform for identifying methodologies to construct viable microgrid systems. Two of the most prominent include the Smart Power Infrastructure Demonstration for Energy Reliability and Security, known as SPIDERS and the Environmental Security Technical Certification Program, or ESTCP.

- SPIDERS is a collaboration between the U.S. Pacific and Northern commands, the Department of Energy, and the Department of Homeland Security. It is multi-phase, with microgrid demonstrations at Joint Base Pearl Harbor-Hickam (Phase 1), Fort Carson (Phase 2) and Camp Smith. Camp Smith will be the third phase of SPIDERS and is planned to be the first base able to operate completely independent of its local utility using a cyber-secure microgrid (DoD, 2013). While SPIDERS supports microgrid development, it is also used to fund demonstration concepts that could be part of a more integrated energy security solution in the future. For example, SPIDERS has provided funding for bidirectional electric vehicles at Fort Carson in Colorado that can feed power back into the grid. These vehicles essentially serve as mobile battery backup and are able to supply electrical power during a blackout.
- ESTCP provides $30 million in grant money every year for similar test beds. At Marine Corps Air Station (MCAS) Miramar, this program funded a battery backup platform and electromechanical windows that adjust in polarization to reduce the solar heat gain of buildings.

These two programs have been instrumental in demonstrating advanced energy technologies. Each of the services also receives research and development funding for energy projects, and many installations have combined these funds with capital dollars at the base level to reduce their energy usage through the use of advanced energy technologies. While these test bed and demonstration efforts have successfully showcased new technologies, they are not designed for widely deploying resilient energy system innovations; they are trial platforms only. New programs will be required to not only scale-up the technologies they have demonstrated, but to also communicate lessons learned across all service branches to ensure that successes can be repeated and failures avoided.

CHALLENGES TO SCALING UP ENERGY SECURITY AND RENEWABLE ENERGY

In order to ensure that renewable energy and security infrastructure can be installed more broadly, DoD will need to address a range of near-term challenges.

Guidance for Energy Security Planning

At present, many installations depend on aging back-up power infrastructure and diesel generators that only have a 72-hour fuel supply. For many installations, creating the ability to operate independent from the local utility over an extended period of time will take a significant investment of resources for infrastructure renovation. While there are comprehensive DoD guidelines for the identification of critical facilities, there are no standard guidelines for integrating renewable into resilient energy systems. As a result, renewable energy will add additional complexity to the process of upgrading and expanding energy security infrastructure.

On-Base Energy Management Expertise

The National Energy Conservation Policy Act of 1978 created the position of "energy manager" for federal facilities, and the Department of Defense Energy Security Act of 2011 (DODESA 2011) provided additional training and certification opportunities for energy managers. Energy managers in DoD are civilians who are tasked with implementing the mandated policies on base, and who are usually subordinate to a senior civilian engineering or public works manager. Most DoD installations had hired energy managers by 2005, but the use and training of energy managers is inconsistent across installations. Some installation energy managers pursue large and complex energy infrastructure projects, whereas others are focused on more basic day-to-day operations. Energy manager staffing levels also vary, and DoD has acknowledged that "the possibility of a facility having the available manpower for pulling together a team for an energy management program is unlikely" and that energy managers would need to utilize contractors as an additional energy management resource (IRTC, 2005).

Even at bases with a track record of successful energy savings projects, energy managers may be constrained by the tools at their disposal. For example, energy managers helped save $411 million through ESPCs during FY2012. These savings, however, typically translate into lower budgets for the installation during the following year instead of returning to the base to be reinvested. At the same time, energy managers can only access base capital dollars on a case-by-case basis for activities such as energy infrastructure, energy training, and resident education campaigns. As a result, energy managers are often limited to undertaking only basic initiatives rather than more complicated energy resiliency efforts. These challenges are compounded by the fact that trained energy managers are much sought after by the private sector. As a result of salary caps for energy managers, bases may have difficulty retaining their most experienced staff.

Without question, integrated and complex energy resiliency systems will require increased energy manager oversight and will add significantly to the duties of the energy manager position. At many bases, however, energy managers may not have the authority, staff, resources, or training to successfully bring energy resiliency projects successfully to conclusion.

Procuring Security

Even if energy managers are equipped to pursue energy security projects, there are currently no clear or standard pathways by which energy managers can procure renewably-fueled energy security systems. DoD's increasingly sophisticated suite of renewable energy procurement options remains limited by requirements that the price of renewable electricity typically not exceed the price of conventional power. Since energy resiliency infrastructure often comes at a price premium, renewable energy procurement cannot be structured to simultaneously enhance on-base energy security. As discussed above, ESPC contracts have allowed for significant energy infrastructure upgrades, but the degree to which energy security can be blended into ESPC contracts will likely require additional guidance if it is to be used as a vehicle for renewables and microgrids.

One of the ways that energy security is currently being integrated into procurement decisions is by using an "energy return on investment" calculation (eROI) (Boyette, 2012; CNO, 2012). In 2010, the Navy created an eROI tool to compare and prioritize potential energy investments. Under the eROI, projects are evaluated using a system of weighted indicators. One of the indicators is the ability of an energy project to "provide reliable energy to critical infrastructure" (Boyette, 2012; Clark, 2012). By incorporating this indicator, energy security explicitly influences energy procurement decision making. The eROI tool is not in standard use across the services, however.

Communities and Utilities

Achieving energy security can require complex and careful coordination with both utilities and the surrounding communities. There may be regulatory challenges at the state or local level associated with complete energy islanding. DoD may also have difficulty navigating how to assert its security prerogative over the standard protocols that govern customer-utility relationships. This complexity can be further increased by DoD procurement vehicles and procurement practices. In the case of MCAS Miramar, for example, the Marine Corps does not have the authority to purchase power directly from San Diego Gas & Electric but instead technically purchases power from Naval Facilities Engineering (NAVFAC) Southwest. This has required significant inter-command cooperation in order to orchestrate the construction of that facility's microgrid. The same is true for many federal facilities that depend on intermediate federal power purchasers.

In addition to increasing energy security on base, bases could also simultaneously support community resiliency by, for example, connecting critical community infrastructure (e.g. water treatment and food banks) to the base microgrid.

Beyond coordination efforts, there are also important opportunities for military bases to engage both the communities that surround them as well as the utilities that serve them when contemplating energy security measures. In addition to increasing energy security on base, bases could also simultaneously support community resiliency by, for example, connecting critical community infrastructure (e.g. water treatment and food banks) to the base microgrid. Doing so, however, could require redefining the traditional role (and service territory) of the utility – which may not be feasible or popular (BENS, 2012).

ENERGY SECURITY AND RENEWABLE ENERGY SOLUTIONS

Establishing energy security powered by renewable energy on DoD installations will require a mix of solutions, from better retention of human capital to developing new procurement tools and modifying existing ones. The following solution set, based on the challenges previously identified, provides both general recommendations and specific measures to achieve energy security on military installations.

Guidance for Energy Security Planning

In order to better standardize the formal renewable energy and energy security requirements for bases, energy security should be considered during the development of installation master planning. A planning document, including definitions and technical standards for what resilience implies and requires in terms of technology should be included. The Army, for instance, already requires a Sustainable Design and Development Policy Master Plan on each of its installations but this document does not include provisions for energy security. A standard and integrated approach to considering mission criticality, power outage risk, and local renewable energy resources would provide useful guidance for base energy planners and managers.

Recommendation: Develop Enhanced Energy Security Plans

Each installation should be required to determine what energy security would require on their individual facility and how local renewable resources could be leveraged to help achieve it. A ranking of facility criticality and energy back up requirements could be included as part of this master planning exercise.

The various microgrid test beds and experiments have been excellent forums to better understand the nuances of microgrid implementation. However, it is not clear that the lessons learned from each of these programs have been well communicated across DoD.

Recommendation: Generate a method and platform to communicate best practices

The Federal Energy Management Program (FEMP) does an excellent job of keeping energy managers informed and educated on new technologies and policies within the federal space. This program might also be the appropriate venue (or model) by which to communicate microgrid lessons learned and best practices.

On-Base Energy Management Expertise

Much of the complexity associated with energy security stems from local differences in base geography, utility involvement, and existing infrastructure. Base energy managers are in the best position to affect change when they are given the tools, training and authority to advance resilience measures for their unique location. Energy managers have the potential to not only change infrastructure, but also to impact base culture, creating responsibility for energy management building by building. Providing energy managers with increased authority and funding will empower them to enact policies and changes that will better lay the groundwork for resilient installations.

Recommendation: Increase positional authority for Energy Managers

Equip energy managers with the tools they need to better perform their jobs, including the option to add staff, manage a budget for capital expenditures, and receive more competitive compensation through an elevated maximum GS pay grade.

Rather than create a new source of funding, the existing savings created through energy reduction should be turned back over to energy managers to use at their discretion. This will further encourage savings, create resources that could be expended on energy security, and serve to forge the local partnerships that are vital to the creation of resilient installations.

Recommendation: Create an Energy Savings Investment Fund

Currently, revenues and cost savings from DoD energy investments and programs cannot be captured and reinvested programmatically. Funds must be taken as a credit off the installation's utility bill, which creates significant bureaucratic hurdles and perverse incentives. Enabling legislation to allow installations access to these funds would significantly support current and future installation energy activities.

Procuring Security

DoD has the opportunity to formally recognize the value of energy security and the associated security tradeoffs that come with obtaining energy from both the national electric grid and from renewable energy systems that cannot be backed up or tied to critical on-base loads.

Authorization is needed for a standard approach to the value calculation associated with energy security across the services. This could then be integrated into the same cost-benefit analysis by which efficiency and renewable projects are currently judged. Recognizing the quantitative security benefit of resilient energy infrastructure would not only allow DoD decision making to be more flexible, it could also serve as a template for homeland security decisions across the federal government, as well as at the state and local levels. This standard approach could draw on lessons learned from the Navy's eROI approach. [6]

A related approach could be to establish "tiers" for analyzing and approving investments in resilient renewable energy based on the criticality of the facilities in question. Critical facilities, for example, could be allowed to procure renewable energy and energy security infrastructure at a higher price point than might otherwise be approved or by using new forms of contracting. Energy security PPAs, for example, could be authorized to pay the conventional rate for renewable power and a fixed payment for "security services" provided by the resilient infrastructure. This would be analogous to capacity payments for generators that are compensated for their ability to stand by and dispatch power only when needed (e.g. at peak periods to avoid power system emergencies).

The development of such authorizations could encourage the private sector to develop new business models. Recent analysis of third party-owned microgrids concluded that "microgrid as a service" models could become viable in the future, but it is expected that customer-owned and operated microgrids will remain the dominant model in the near-term (Frankel, 2013). Given DoD's interest in energy security and in alternative financing mechanisms, however, there is an opportunity for military bases to partner with the private sector to support the development of innovative business and ownership models for microgrids (BENS, 2012).

Recommendation: Develop a Secure Energy Assurance Program

As a concrete and near-term step, DoD should provide funds to support projects on DoD installations that improve facility energy security. This funding could mirror the existing Energy Conservation Investment Program (ECIP) where projects are rated based on a "Savings-to-Investment Ratio (SIR)." The Office of the Secretary of Defense (OSD) could develop an "Assurance-to-Investment Ratio (AIR)" that weighs a reduction in risk to mission against the project cost, relative to maintaining the status quo or executing other risk-mitigation options. By establishing a program in this manner, DoD would simultaneously support the scale-up of energy security innovation while also defining the process by which future energy security investments would be evaluated. Once an AIR is created, a wide range of existing procurement pathways will be able to bundle resiliency into efficiency or renewable projects. Microgrid projects and battery storage technology, for example, could be scored like an energy conservation measures (ECM) and included in ESPCs.

Communities and Utilities

As discussed above, an installation's relationship with its local utility and surrounding community are vital to establishing and implementing a successful energy resilience strategy.

Bases with onsite renewable generation, back-up power, or microgrids can partner with local utilities to participate in (and earn revenue from) emergency demand response programs and ancillary services markets, where available. Installations can also partner with local governments and utilities to jointly pursue resiliency planning that results in enhanced energy security for all parties. Bases can support renewable energy resiliency for critical municipal infrastructure, whereas local utilities and communities can support the elements of microgrid development over which they have jurisdiction.

The current focus on climate adaptation and preparedness at the national, state, local, and utility levels could also lay the foundation for joint energy security efforts. The 2014 Quadrennial Defense Review specifically refers to the need to evaluate the "operational resiliency" of installations with regard to the impacts of climate change (DoD, 2014). Such evaluations would likely need to take into account the impacts of climate change on surrounding communities and geographies and could provide a foundation for dialogue about energy security and energy planning with communities. At the same time, non-military climate preparedness initiatives could create opportunities for bases to adopt best practices. Following the devastation wreaked by Hurricane Sandy, for example, the New York Public Service Commission ordered Con Edison to plan for the impacts of climate change and implement strategies to protect its energy infrastructure (PSC, 2014). The experience of Con Edison and other utilities with adaptation planning could create opportunities for military bases to engage with their local utilities around energy security and resilience.

Recommendation: Encourage energy resiliency partnerships between installations, and their communities and utilities

The authority for intergovernmental partnerships is provided by 10 US Code § 2336.[7] DoD should encourage energy resilience partnerships under which installations meaningfully and productively engage with local governments and utilities. Examples of successful partnerships that mutually reinforced the missions of each party while enhancing energy security should be captured and developed into best practices guidance.

BIBLIOGRAPHY

- Anderson, W. C. (2014). Energy security and microgrids: Protecting critical infrastructure from impacts of extended grid outages. In *Renewable energy for military installations: 2014 industry review*. Washington, DC: American Council on Renewable Energy.
- BENS Task Force on Microgrids. (2012). *Power the fight: Capturing smart microgrid potential for DoD installation energy security*. Washington, DC: Business Executives for National Security.
- Boyette, M. R. (2012, February 6). *eROI template users manual*. Presented at the International District Energy Association 25th Annual Campus Energy Conference, Arlington, VA.
- Clark, B. (2012, April 11). *UESC case study: Kings Bay Trident Training Facility*. Presented at the Federal Utility Partnership Working Group Meeting, Jekyll Island, GA.
- Closson, S. (2013). The military and energy: Moving the United States beyond oil. *Energy Policy*, *61*, 306–316.
- Defense Science Board. (2008). *Report of the Defense Science Board Task Force on DoD Energy Strategy: "More fight - Less fuel."* Washington, DC: United States Department of Defense.
- Foster, J. S., Gjelde, E., Graham, W. R., Hermann, R. J., Kluepfel, H. M., Lawson, R. L., et al. (2008). *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack: Critical national infrastructures*. Washington, DC: Commission to Assess the Threat to the United States from Electromagnetic Pulse.
- Frankel, D. (2013). *Microgrids: How business model innovation will support new development opportunities*. Boston, MA: Lux Research.
- Gibbs, L. I., & Holloway, C. F. (2013). *Hurricane Sandy after action report and recommendations to Mayor Michael R. Bloomberg*. New York, NY: City of New York.
- Halper, E., & Lifsher, M. (2014, February 6). Attack on electric grid raises alarm: Damage to power station in shooting last year prompts worries over terrorism. *Los Angeles Times*.
- Intuitive Research & Technology Corporation. (2005). *Department of Defense energy manager's handbook*. Washington, DC: Department of Defense.
- Koch, A. S. (2014). The policy context for military renewables: Rethinking state regulatory issues. In *Renewable energy for military installations: 2014 industry review*. Washington, DC: American Council on Renewable Energy.
- National Research Council. (2012). *Terrorism and the electric power delivery system*. Washington, DC: The National Academies Press.
- Office of Electricity Delivery & Energy Reliability. (2012). *Hurricane Sandy situation report #20: November 7, 2012 (10:00 AM EST)*. Washington, DC: US Department of Energy.
- Office of the Chief of Naval Operations. (2012). *OPNAV Instruction 4100.5E: Shore energy management*. Washington, DC: Department of the Navy.
- President's Council of Economic Advisers, & U.S. Department of Energy Office of Electricity Delivery and Energy Reliability. (2013). *Economic benefits of increasing electric grid resilience to weather outages*. Washington, DC: Executive Office of the President.
- State of New York Public Service Commission. (2014). *Order approving electric, gas and steam rate plan in accord with joint proposal* (Case 13-E-0300, Case 13-G-0031, Case 13-S-0032, Case 13-M-0376, Case 13-M-0040, Case 09-E-0428). Albany, NY.
- Stockton, P. (2011). *Testimony of the Honorable Paul Stockton, Assistant Secretary of Defense, Homeland Defense and Americas' Security Affairs, Department of Defense before the Subcommittee on Energy and Power, the Committee on Energy and Commerce, United States House of Representatives May 31, 2011*. Washington, DC: United States House of Representatives.
- The Pew Charitable Trusts. (2014). *Power surge: How the Department of Defense leverages private resources to enhance energy security and save money on U.S. military bases*. Philadelphia, PA and Washington, DC.
- United States Department of Defense. (2012). *Strategic sustainability performance plan FY 2012*. Washington, DC.

- United States Department of Defense. (2013). *Annual energy management report Fiscal Year 2012*. Washington, DC.
- United States Department of Defense. (2014). *Quadrennial Defense Review 2014*. Washington, DC.
- United States Government Accountability Office. (2009). *Defense critical infrastructure: Actions needed to improve the identification and management of electrical power risks and vulnerabilities to DOD critical assets* (GAO-10-147). Washington, DC.
- United States Government Accountability Office. (2014). *Climate change: Energy infrastructure risks and adaptation efforts* (GAO-14-74). Washington, DC.

ENDNOTES

[1] Nine days after Hurricane Sandy made landfall, over 650,000 customers remained without power in NJ, NY, PA, and WV (OEDER, 2012). Some customers remained without power for weeks. After three weeks, for example, over 16,000 customers in hard hit areas of New York City remained without electricity (Gibbs & Holloway, 2013).

[2] The 2013 substation attack did not cause a power outage because it occurred during a period of low demand. Substations and transformers, however, are difficult to replace. They take 12 to 16 months to manufacture and then require several more months to transport and install.

[3] In 2009, for example, GAO surveyed 34 facilities identified as DoD's most critical and found that 31 primarily rely on the electric grid, and that 24 had experienced significant power outages during the study period (GAO, 2009).

[4] Section 2822 of the FY2012 National Defense Authorization Act (NDAA) required that the Annual Energy Management Report (AEMR) include the number, frequency, and impact of outages, as well as mitigation actions being undertaken. Prior AEMRs did not include this information.

[5] Section 2821 of the FY2012 NDAA defines energy security as "assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet mission essential requirements."

[6] A similar concept for a levelized cost of secure energy (LCOSE) metric has been proposed by Business Executives for National Security (BENS, 2012). The LCOSE would take into account the "avoided lifecycle costs of any on-base back-up generation that a microgrid would render unnecessary" and would improve the position of microgrids in comparative analyses.

[7] Section 2336 allows for "Intergovernmental support agreements with State and local governments" and states that "The Secretary…may enter into an intergovernmental support agreement with a State or local government to provide, receive, or share installation-support services if the Secretary determines that the agreement will serve the best interests of the department by enhancing mission effectiveness…"

This publication was made possible in part by a grant from the Carnegie Corporation of New York, and by funding from the 11th Hour Project. The statements made and views expressed are solely the responsibility of the author.

Printed in-house with volunteer labor.