SURGE
ENERGY ACADEMIC GROUP QUARTERLY NEWSLETTER SUMMER 2024

Highlights

Aerial of Silver Peak, Neveda lithium mining operation (NASA Earth Observatory)

ENERGY RESEARCH

Battery Workforce Development Phase I Concludes, Educational Offerings Forthcoming

By Gianluca Douros, Faculty Associate—Research, Energy Academic Group

In collaboration with the Department of Defense (DoD) Industrial Base Analysis and Sustainment program (IBAS), the Energy Academic Group's (EAG) Battery & Energy Storage Technologies (BEST) team recently completed Phase 1 of the Battery Workforce Development project—the Strategic Roadmap. With the goal of reducing the systemic deficiencies currently hindering the development of a U.S. domestic battery workforce, the Strategic Roadmap identifies seven proposals to close critical gaps in education, workforce training, and industry coordination.

The proposals range from creating and improving access to battery education to nationwide recruitment efforts for both students and educators alike. The project is comprehensive in scope and assesses needs and deficiencies within all sectors of the battery value chain, from upstream mineral activities to manufacturing and end-of-life recycling and reclamation. The completion of the Strategic Roadmap marks the commencement of Phase 2 of the Battery Workforce Development project, where the proposals set forth will be enacted by various entities, as determined by the project's sponsors.

During Phase 1, the research team, led by Dr. Mary Sims, leveraged connections within the DoD, Department of Energy (DoE), academia, and industry to identify both ongoing efforts as well as critical gaps that remain. Phase 1a included a preliminary assessment of parallel or redundant projects in the battery workforce space. The results of phase 1a informed phase 1b which produced a Strategic Roadmap for development of the battery workforce.

As the research team developed the proposals and courses of action which formed the Battery Workforce Development Strategic Roadmap, it was revealed that an urgent need exists for battery education among engineers across the naval enterprise, and DoD asked the EAG to create education programs that fill this gap.

In response, the EAG Curriculum Development team is creating a battery education program which will be delivered through short courses and academic certificates. The program will be delivered via both residential and distance learning

Continues on page 3

From the Chair

Dan Nussbaum, Chair of the Energy Academic Group

Demand for energy is growing across most countries in the world, as standards of living rise and populations increase. If this increased demand is not offset by improvements in energy efficiency or technology advances elsewhere, then our total annual global energy consumption will continue to grow, stressing already constrained resources.

So, here is the macro-question: "Will we have enough energy in the future to meet our needs?" I will begin by addressing a sub-category of this question, namely "Is the evolution of using more renewable energy generation sources, instead of fossil fuel generation sources, keeping pace with the growth of our overall energy needs?"

To answer this question, we need to collect some data and do some analysis with that data. Analysis of measured results is fundamental in science because it transforms raw data into meaningful information, facilitates understanding, supports the development and testing of theories, and ultimately advances scientific knowledge. Any analysis should have goals from among the following: disentangle complications; identify patterns that can underpin new hypotheses and models; test hypotheses and draw conclusions; and ensure validity, reproducibility, and reliability of the results.

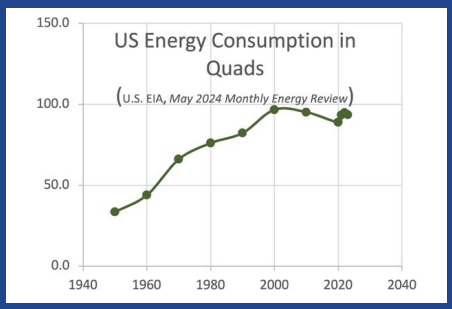
In this article, while I can consider this question from a global perspective, I will start by just focusing on the U.S., and will look at the following:

- growth of overall U.S. energy demand in the past and projected into the future;
- growth of renewable generation, defined as energy generated from conventional hydropower, biomass, geothermal, solar, and wind, in the past and projected in the future; and
- fraction of the energy growth that is covered by the growth in renewals.

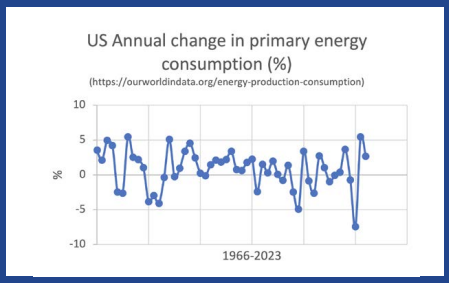
I will end this article with some observations and conclusions. However, I appeal to all readers for your comments and suggestions for future research along these lines.

We need a metric to talk about the energy-use data we collect. There are several ways to measure energy content, and there is always the problem of converting the energy output of one source—for example, petroleum—to the output of another source, such as solar panel. Nevertheless, there are some accepted conversions. In this article I will convert everything into "Quads", where one Quad is a quadrillion British thermal units (BTUs). That is 10 to the 15th power BTUs. The quad is a convenient unit for describing energy resources. For context, it's equal to 293 billion kWh, or the energy of 183 million barrels of petroleum. For further context, the world uses about 100 million barrels of oil per day.

U.S. annual energy use is approximately 100 Quad per year. Here is a chart showing its growth over time.



The annual growth in total energy use in the U.S. is quite variable, sometimes positive, and in times of economic stress, it can even be negative. The graph below shows this variability.



How much new energy generating capacity do we need, just to keep pace with projected demands? There are two sources of demand:

- Annual growth rate of new U.S. energy demands is one source. It seems reasonable to me to assume an annual growth rate of U.S. energy demands of 1%, given the new demands that will come from population increases, modest economic growth, AI use cases, bitcoin mining, and the reshoring of manufacturing to the U.S., which is implicit in the Inflation Reduction Act. For a comparison, world growth rates of annual energy demand are in the 2–4% range, 2 to 4 times this projected U.S. rate.
- New generating capacity must replace legacy assets that will retire due to age. The percentage of energy generation assets that will age out varies based on the type of asset, its lifespan, and the region in question. Still an estimate of 2–3% annually, across the U.S., seems reasonable.

Using the above growth and replacement factors means that we have a requirement of 3-4% (equivalent to 3-4 Quads) of new generating capacities online each year. This new generating capacity will come from two sources: fossil fuel generated, and non-fossil-fuel (renewables, nuclear).

Non fossil fuel energy sources accounted for 21% of U.S. energy consumption in 2022, which means that they accounted for approximately 20 Quads, (https://tinyurl.com/vy7n6vmu).

For 20 Quads to grow enough to cover the 3–4 Quads needed, the renewable portfolio must grow at 15–20% per year. However, data from the same source (https://tinyurl.com/vy7n6vmu) indicates historical growth rates in the 2–6% range, insufficient for the task at hand. Using the upper value of 6% growth permits an initial increase of about 1.2 Quads derivable from renewables, leaving the remaining 1.8-2.8 Quad requirement to be filled by fossil fuel.

Observations:

- A simple "how fast does it grow" analysis casts doubt on the proposition that renewable energy sources can, in the near term, fill U.S. energy growth needs.
- If we are not going to be able to meet this modest demand placed by growth and replace installed legacy capacity with RES sources, how are we going to replace the rest of the installed oil and gas legacy capacities by 2050 to get to net zero carbon?
- Changes in growth rates or in technology developments, can, as always, alter the analysis. Which of these developments is most likely to shed a positive light on renewables?

There is much going on, and I encourage you to reach out to me. I would be happy to hear your ideas.

CONTACT
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or call 831-324-3228.

modalities and will be, at least initially, aimed at DoN engineering personnel. The program's goal is to standardize knowledge of batteries for DoN engineers in the field, leaving them with systems engineering best practices that equip them to serve the warfighter and the fleet.

The development of the battery education program is underway, and the Curriculum Development team is soliciting input from the fleet with respect to delivery mode and content of greatest interest. If your unit or organization seeks battery education for engineering personnel and would be interested in learning more, please contact Gianluca Douros at gianluca.douros@nps.edu to coordinate a discussion.

LEARN MORE

Contact Gianluca Douros at gianluca.douros@nps.edu

ENERGY POLICY

Washington Denies a Bedrock of Warfighting

By Alan Howard, Associate Chair, Energy Academic Group, and Dr. Brenda Shaffer, Faculty Associate-Research, Energy Academic Group

This article originally appeared in RealClearEnergy and is reprinted with permission.

The Biden administration recently pressed Ukraine to halt attacks on Russian oil refineries. Ukrainian strikes on refineries and tankers in the Black Sea have contributed to a rise in the global oil price, and specifically of oil products, especially diesel. Almost the last thing the Biden administration wants in an election year is higher fuel prices and associated inflation in other goods and services. But in acting to halt rising oil prices, Washington is undermining the Ukrainian war effort. Denying energy supplies to the adversary in war has long been a bedrock of military strategy. Washington's policy toward adversary fuel supplies is likely to lengthen the Ukraine-Russia war, as well as the Gaza war.

READ THE FULL ARTICLE

Visit RealClearEnergy for full article at https://tinyurl.com/3xs547pk

Energy Academic Group Welcomes New Team Member

Dr. Karen Flack joined the Energy Academic Group (EAG) in May 2024 as a Research Professor. As a Professor Emeritus at the United States Naval Academy (USNA), Karen brings to EAG a wealth of experience in Navy energy education. During her long tenure in the Mechanical Engineering Department, she served as chair and taught courses in thermodynamics, fluid mechanics, heat transfer, and renewable energy. She also coordinated a multidisciplinary course in energy security with faculty in Economics, Oceanography and Political Science and is collaborating with these colleagues to write a book on energy security. An established researcher in fluid mechanics, she has published numerous papers on turbulent boundary layers and tidal energy. Karen collaborated extensively with the Energy Academic Group while a USNA faculty member via workshops, seminars, midshipmen capstone projects and a faculty sabbatical. She will be working with the Climate and Security team supporting curriculum development and the Education Partner Agreement with the Doerr School of Sustainability at Stanford. Feel free to contact and welcome Karen at **karen.a.flack@nps.edu.**

Dr. Karen Flack

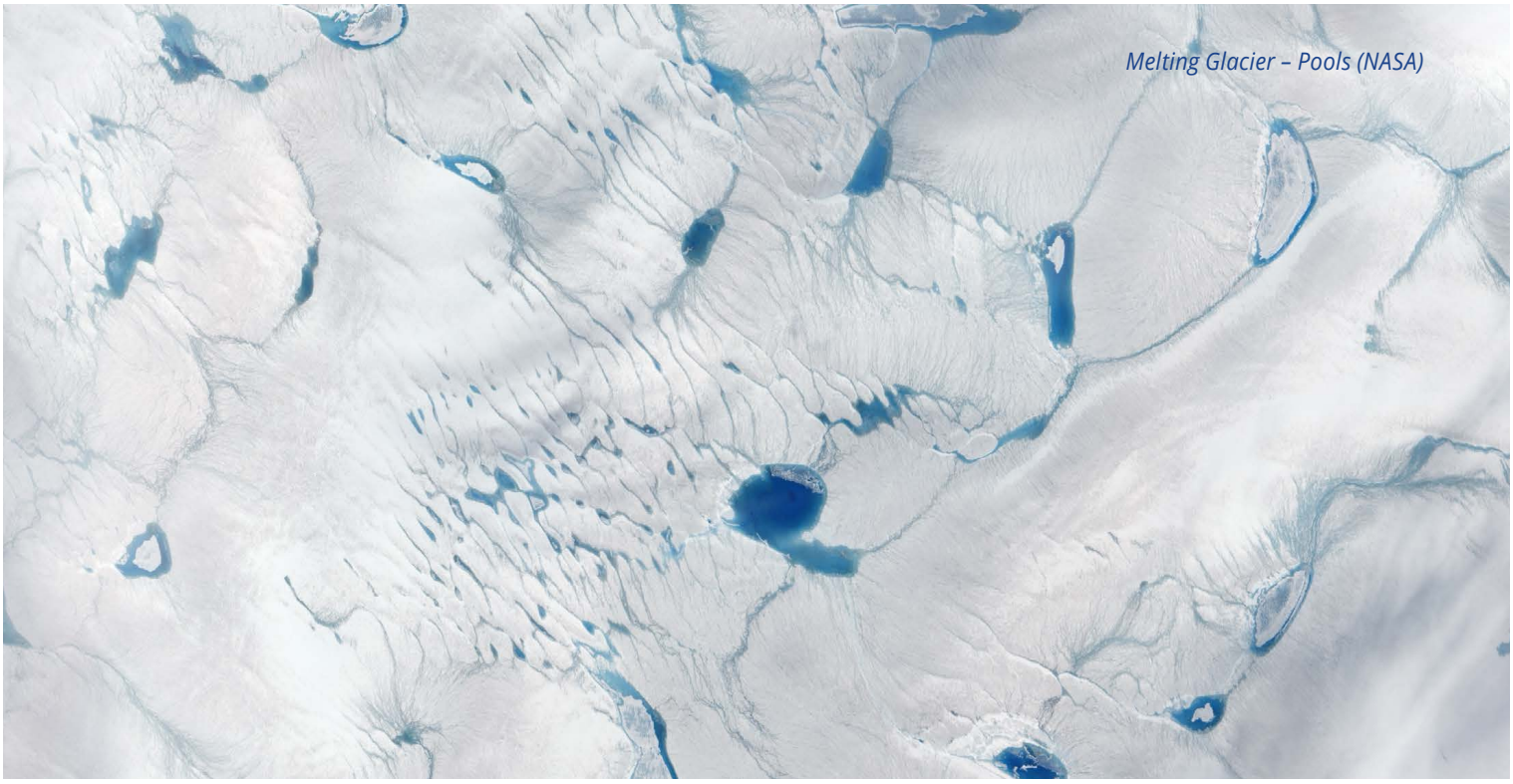
Refuel Logistics Certificate Course

The Naval Postgraduate School is pleased to announce the Operational Energy Certificate: Refuel Logistics beginning Spring Quarter AY2025. The Certificate is sponsored by OPNAV. The certificate program is an accredited graduate program that consists of four on-line courses, delivered one course per quarter for four quarters.

The Refuel (Contested) Logistics Certificate, curriculum number 121, commences Spring Quarter, Academic Year 2025. An application and participation agreement are required by December 13, 2024.

LEARN MORE

For all program information and course requirements, please visit **https://nps.edu/web/eag/operational-energy-certificate** or email the program manager, Dr. Colleen McHenry, at **colleen.mchenry@nps.edu**.



Melting Glacier – Pools (NASA)

CLIMATE SECURITY

Sea Level Rise Threatens Naval Readiness

By Kristen Fletcher
Faculty Associate-Research, Energy Academic Group

In May, the NPS Climate & Security Network partnered with the Naval Warfare Studies Institute to host a Seapower Conversation on sea level rise. The event was entitled Navigating the Tide: Rising Seas as a Threat to Readiness and featured experts on sea level rise science, data and information and installation resilience. Panelists included John Englander of the Rising Seas Institute, Tracey Spencer from Marine Corps Recruit Depot Parris Island, Steve Jones from Naval Station Norfolk, and Rachael Dempsey from NOAA's National Ocean Service. The panel was moderated by Stuart Gold of the Rising Seas Institute.

The esteemed panel discussed the on-the-ground and on-the-water challenges of sea level rise for military operations and installations, sharing information and perspectives on global sea level rise, how it impacts Marine Corps Recruit Depot Parris Island and Naval Station Norfolk, and how we can use data and modeling to navigate in today's and tomorrow's rising seas.

Installations are particularly challenged as they must work within the parameters of Department of Defense guidance and instructions, along with budgetary constraints for addressing infrastructure issues. There is often a long list of base infrastructure repairs with limited funding; in addition, budgetary challenges include the increase in costs due to climate change related damage to infrastructure.

In addition, installations are not islands; they are a part of and connected to the communities that surround them. As a result, partnering with local, regional, and state governments and other entities is critical. However, there can be limits in the ability to share information among partners, especially in the case of classified information or controlled unclassified information (CUI). Fortunately, sea level rise data from the National Oceanic and Atmospheric Administration is unclassified and available publicly; this allows for sharing among domestic and international partners.

The panel concluded with agreement that whether funding is available or not, there are small efforts that need to be made now to address the challenges we will face in the future.

LEARN MORE

Visit the event video, slides and resources at: **https://nps.edu/web/climate-and-security/past-events#37**

Contact: Kristen Fletcher at **kristen.fletcher@nps.edu**

ENERGY OUTREACH

Energy Academic Group Leads Energy Resilience Tabletop Exercise in the Philippines

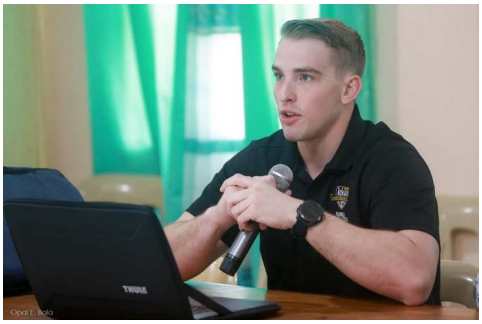
By Charles Lynn,
Faculty Associate-Research,
Energy Academic Group

The Energy Academic Group (EAG) developed and facilitated an energy resilience tabletop exercise (TTX) in the Batanes island chain, Philippines, from 22–26 April 2024. Systems Engineering department faculty members Dr. Douglas Van Bossuyt and Col Nelson Emmons (USA, ret.) brought their expertise to the TTX, as did three NPS students: MAJs Louie Flores and Kyle Shulz, and Capt. Christopher Reardon. Key partners from the U.S. military included the USMC Expeditionary Energy Office, the USMC III Marine Expeditionary Force, and the USMC 3d Civil Affairs Group. The event, designed to highlight vulnerabilities in existing energy and energy-dependent systems in the island chain that comprises the Philippines northernmost province, took place during the Balikatan 24 multinational exercise.

Over seventy representatives from various agencies in the Philippines also participated in the TTX. Included in this count are officials from the national Office of Civil Defense, the Batanes Province Governor's office, the Batanes Province Disaster Risk Reduction Management office, the Armed Forces of the Philippines, local utility providers, first responders, and other community representatives.

Batanes Province, strategically located in the Luzon Strait, sits roughly 200 nautical miles from both Luzon and Taiwan. Over the last several years, this isolated location has been the recipient of increased attention from military planners. In addition to its operational relevance, the province is a frequent target of typhoons and earthquakes, resulting in damage to its energy systems and other critical infrastructure. One of the outcomes of the TTX was identifying ways to mitigate operational risks by building resiliency and redundancy into those systems.

Over 70 participants from the U.S. and the Philippines participated in an Energy Resilience and Readiness TTX in Batanes Province, Philippines, from 22–26 April 2024. The TTX was designed and facilitated by the Energy Academic Group and supported by faculty and students from across several departments at NPS.

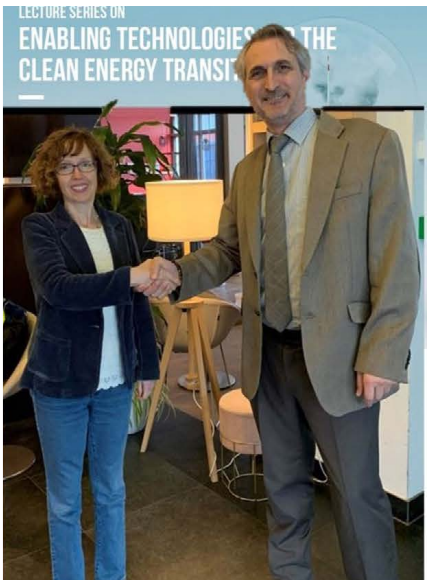


NPS Student, Captain Christopher "Jimmy" Reardon, discusses key takeaways at the conclusion of the Energy Resilience TTX.

The TTX used two principal scenarios to notionally stress the energy and energy-dependent systems in the province. The first was a natural disaster in the form of a super typhoon. The second scenario simulated the repatriation of thousands of overseas Filipino workers into the province from a nearby island nation. In the event of an actual crisis involving Taiwan, Batanes Province has a mission to receive tens of thousands of overseas workers currently employed there. Using the TTX methodology, collectively working through both of these complex problem sets highlighted numerous planning factors and decision points for all participants to take into account. A comprehensive final exercise report, detailing the work that took place during the TTX and recommending ways to mitigate risks to energy and energy-dependent systems in the province, will be published and distributed later this summer.

LEARN MORE

Contact Charles Lynn at
charles.lynn@nps.edu



ENERGY RESEARCH

NPS presents at the Luxembourg Institute of Science and Technology lecture series in support of the Clean Energy Transition

By Giovanna Oriti, PhD, Electrical and Computer Engineering Department

Dr. Giovanna Oriti recently presented at a lecture series organized by the Luxembourg Institute of Science and Technology (LIST) entitled "Enabling Technologies for the Clean Energy Transition" as one of several world-renowned subject matter experts invited to participate. The goal of the lecture series, which took place between September 2023 and May 2024, was to "explore the pioneering technologies that will transform our carbon-dependent society to a carbon-neutral one". The lecture series is sponsored by the Luxembourg National Research Fund and supported by the Institute of Electrical and Electronics Engineers (IEEE) Benelux joint chapter of the Power Electronics Society (PELS), Industry Applications Society (IAS) and Power and Energy Society (PES). Dr. Oriti's lecture was also co-sponsored by the San Francisco Bay Area Council PELS Chapter, for which she serves on the executive committee as a member-at-large.

Dr. Oriti 's lecture entitled "The Role of Active Microgrids in the Clean Energy Transition" was attended by LIST researchers and virtual attendees worldwide. Her presentation highlighted several research projects Dr. Oriti has led over the past twelve years, during which time she developed power-electronics based energy management systems for mobile and facility microgrids. Microgrids are crucial for incorporating renewable energy resources like wind and power to enable the clean energy shift. This lecture introduced resilient microgrids, key for improving energy efficiency, reducing fossil fuel use, and reliably powering critical loads in various applications. It also discussed their designs, control strategies, and system analyses, along with real-world uses and technology transfer, showcasing their importance across different settings. Additionally, the lecture introduced the advancements in microgrid resilience carried out by the multidisciplinary group "Microgrid Innovation Team" at the Naval Postgraduate School, including the microgrid design tools available on the website **microgrid.nps.edu**, which is being used by energy managers for the design of microgrids to service critical loads.

Potential collaborative ideas were also discussed with the LIST researchers, including dc or hybrid ac/dc microgrids for deployment in geographical areas where the power grid has been damaged.

The presentation concluded with an expression of gratitude to the host, the sponsor and the organizers as well as Dr. Oriti's research sponsors over the years: the Office of Naval Research NextSTEP, NAVFAC NSETTI, the DASN-Operational Energy office, and the Office of Naval Research Code 33. The lecture was followed by Q & A, as the material presented resonated with the audience and stimulated interesting thoughts and ideas.

LEARN MORE

Contact Prof. Giovanna Oriti at **goriti@nps.edu** for more information. The lecture series website can be found at: **https://tinyurl.com/23x4euvu**

ENERGY RESILIENCE

NAS Sigonella Executes Nanogrid Design Review with NPS Support

By Douglas Van Bossuyt, PhD, Systems Engineering Department

NPS faculty members Dr. Giovanna Oriti (professor, Electrical and Computer Engineering [ECE] department) and Dr. Douglas L. Van Bossuyt (associate professor, Systems Engineering [SE] department) recently attended a design review for the Navy's first nanogrid that is slated for construction at Naval Air Station Sigonella. The nanogrid has been designed based upon principles developed over the past five years at the Naval Postgraduate School by Dr. Oriti, Dr. Van Bossuyt, Dr. Ron Giachetti (professor, SE), Dr. Daniel Reich (assistant professor, Operations Research [OR] department), Dr. Susan Sanchez (distinguished professor emeritus, OR department), Dr. Preetha Thulasiraman (associate professor, ECE), Dr. Hyatt Moore (research professor, SE), and many other professors and students plus colleagues at NAVFAC EXWC, the University of Wisconsin-Milwaukee, and the University of Pavia. The first nanogrid expected to be constructed at NAS Sigonella is part of the zonal nanogrid philosophy developed at NPS that takes the concept of zonal shipboard power and brings it ashore in a way that allows for small, incremental improvements to be made to existing electrical utility infrastructure at Navy bases. Zonal nanogrids help to improve energy resilience for individual or small groups of critical loads.

NAS Sigonella

LEARN MORE

More information is available at **https://microgrid.nps.edu**

Contact Dr. Douglas Van Bossuyt at **douglas.vanbossuyt@nps.edu** for more information about this research.

Operational Energy Research Available on Calhoun

All NPS resident students write a thesis or capstone project report as part of their curricular requirements. Many theses are unclassified and accessible on Calhoun—the Naval Postgraduate School's digital repository for research materials and institutional publications created by the NPS community. To access theses which involve operational energy, please use the following link. New theses are added every quarter.

View operational energy theses available on Calhoun:
https://calhoun.nps.edu/

CLIMATE CHANGE

Impact of Climate-Induced Extreme Weather Events on U.S. Military Installations

Emily A. Pesicka, PhD, Energy Academic Group & Center for Infrastructure Defense

A recent Naval Postgraduate School Technical Report, "Installation Resilience to Weather Extremes and Climate Change: Learning from Recent Surprises," by Emily A. Pesicka, Daniel A. Eisenberg, and David L. Alderson, reveals that extreme weather events driven by climate change are significantly impacting U.S. military installations. These events are causing severe disruptions and damage inside and outside military bases, with direct costs ranging from millions to billions of dollars. The increasing frequency and intensity of these climate-induced weather events indicate that future financial impacts have the potential to be even more significant.

The report examines twelve climate-driven extreme weather events across CONUS and OCONUS military installations, highlighting the present and future challenges these events pose to military operations. The dependence of military readiness on external civilian infrastructure, including gas, power, water, and transportation, is a significant concern. These dependencies reveal vulnerabilities during extreme weather incidents, often only becoming apparent during or after such events.

A key takeaway from this report is that while installation commanders face limitations in safeguarding against these vulnerabilities, there are opportunities to enhance resilience through community-wide or regional climate resilience efforts. The variability in advanced warnings for extreme weather complicates preparedness and response. Events can last from days to weeks, with recovery taking weeks to years, emphasizing the need for flexible and robust response strategies.

Keesler Air Force Base and Hurricane Katrina

Other findings highlight that better forecasting alone cannot prevent catastrophic outcomes. Climate change creates higher risks outside traditional seasonal weather patterns, complicating event anticipation and preparation. Emergency plans must adapt to unexpected events and imperfect forecasts. Climate-driven disasters also strain military resources, diverting funds from critical areas like equipment modernization and personnel training. This diversion exacerbates existing resource allocation tensions and threatens military readiness for future conflicts.

The report culminates with the recommendation that effective response to climate-driven events relies on *adaptive capacity*—the ability to manage unforeseen challenges. Strategic investments in adaptive measures and continuous training are essential for maintaining readiness. The report emphasizes the urgent need for the U.S. military to adapt to the evolving climate landscape. By investing in resilience and adaptive capacity, the military can better respond to the increasing threat of climate-induced disasters, ensuring operational readiness and national security.

LEARN MORE

Visit the Center for Infrastructure Defense for more information about Installation Resilience and Surprise Theory: **https://nps.edu/web/cid/dystopia**

Contact: Emily Pesicka at **emily.pesicka@nps.edu**

STUDENT ENERGY RESEARCH SPOTLIGHT

T2P: Elevating Installation Energy Resilience TTXs through Systems

By LT Ryan Herrmann, USN

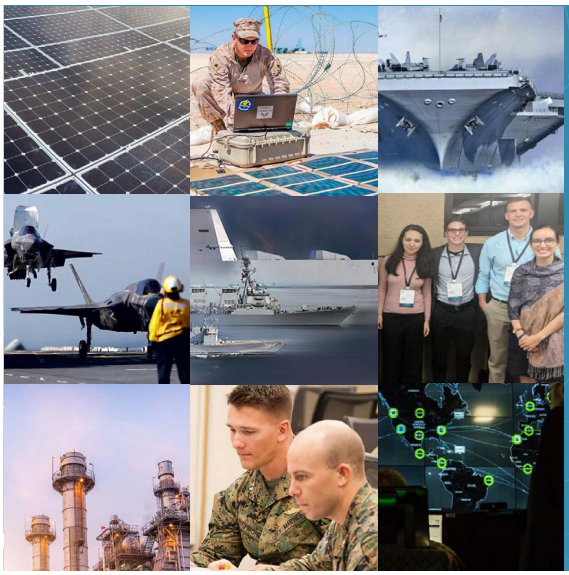
At the Department of Defense (DoD) installation leadership level, there has been a desire for a method underpinned by systems engineering principles that connect existing installation energy resilience tabletop exercises (TTXs) with Naval Postgraduate School (NPS) microgrid tools to help installation energy managers more effectively develop energy resilience-related project proposals. As a result, the Tabletop to Proposal (T2P) process was developed. It comprises three phases and ten steps, starting with stakeholder identification and culminating in solution proposal development.

In the pre-TTX phase, stakeholder identification and needs collection precedes the formulation of top-level requirements that will serve as the foundation for the rest of the process. The second phase involves conducting the TTX to gather data and feedback that will be used to identify gaps in the installation's energy plan. In the post-TTX phase, gap identification and problem definition mark the initiation of solution-oriented efforts. Detailed requirements are then determined, followed by the development of solution alternatives, including the utilization of NPS microgrid tools (https://planner.microgrid.nps.edu). Finally, the selection of a solution and the crafting of a comprehensive project proposal conclude the process.

T2P's strategic grounding in systems engineering principles ensures systematic resilience enhancement, while its accessible format accommodates users with varied expertise. The process maximizes existing strategies and technologies, promoting seamless integration into existing practices. Through meticulous guidance and intentional flexibility, T2P facilitates efficient progression towards bolstered installation energy resilience, vital for mission assurance and continuity.

ABOUT THE AUTHOR

LT Herrmann graduated from the Naval Postgraduate School in June 2024 with a Master of Science in Systems Engineering. Contact Prof. Douglas Van Bossuyt at **douglas.vanbossuyt@nps.edu** for more information about this research.



Interested in Energy-related Thesis Research?

Since 2013, NPS and the EAG have supported a plethora of student thesis research in the area of energy. Publicly viewable student theses can be searched from the Resources page of the EAG website at **nps.edu/web/eag/resources**. The EAG's extensive resources, intellectual capital, and connections with multi-disciplinary faculty and energy professionals provide students enhanced support for energy-related research. If interested in energy research, please reach out to the EAG team!

nps.edu/energy

STUDENT ENERGY RESEARCH SPOTLIGHT

Investigation of Zonal Nanogrids for Improved Military Installation Energy

LT Gabrielle Smith, USN

Protecting critical energy systems is becoming more difficult as the threats to the systems are becoming more complex. Given the rise in incidents caused by technological, economic, and climate-driven events, it is imperative that existing systems are studied from a resilience perspective. Building upon previous work of Naval Postgraduate School (NPS) students and faculty, this study was motivated by the persistent advance in machine learning algorithms and their application for understanding energy systems from a resilience standpoint.

We used the Deep-Q-Network (DQN) algorithm to address repair problems on a generic fuel infrastructure model. The question of interest was if and when to repair broken pipe segments in a dynamic network with redundant pathways. We trained the DQN policy under normal failure rates (consistent with random failure from aging and use) and found it was able to identify and prioritize critical components for repair.

We then exposed the system to a range of scenarios that fall outside of the training parameters used to inform the DQN policy. This was done by simulating deliberate attacks on the infrastructure that destroyed multiple components. Another scenario involved an increased failure rate on components due to extreme weather events.

Collecting large amounts of data on these trials allowed us to find and interpret policies created by the DQN algorithm that can potentially inform operators on repair decisions related to their infrastructure system. The study demonstrated that it is possible to apply these techniques to the study of resilience in energy systems. The results, however, are specific to the underlying instance of the infrastructure in question. Additional work and careful interpretation will be required before these insights are applicable to the dynamics of an infrastructure under surprise conditions.

The study was conducted as a master's thesis in cooperation between the Universität der Bundeswehr München and the NPS Energy Academic Group with the assistance of Dr. Eisenberg and Dr. Alderson from the NPS Center for Infrastructure Defense.

ABOUT THE AUTHOR

LT Gaby Smith, USN, is pursuing a Master of Science in Systems Engineering. She graduated from the Naval Postgraduate School in June 2024. Details of the research will be published in the IEEE ECCE conference in the fall. Contact Prof. Douglas L. Van Bossuyt at douglas.vanbossuyt@nps.edu for more information about this research.

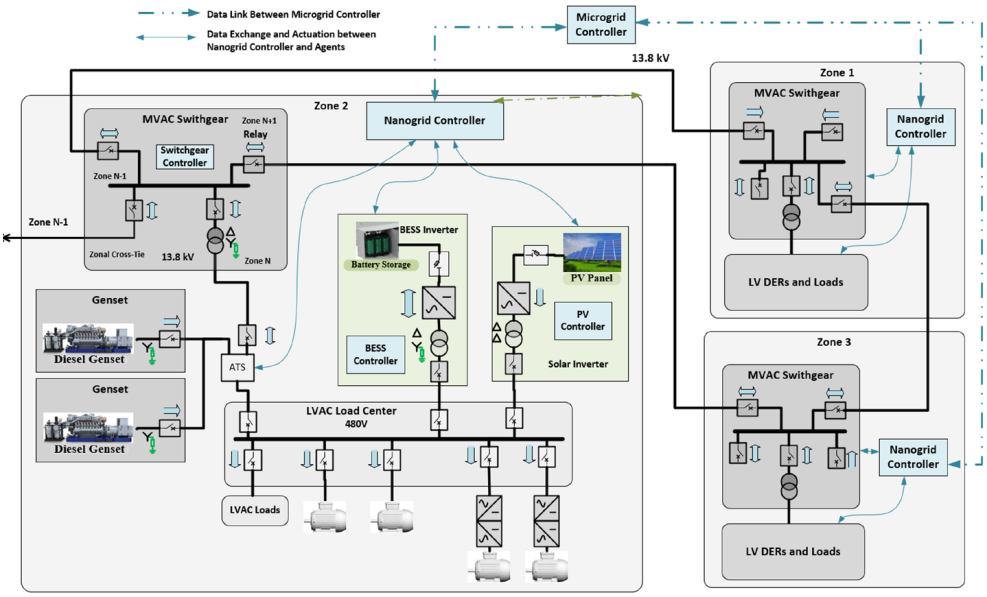


Figure 1: Centralized Zonal Nanogrids Architecture

Calendar of Events and Important Dates

JULY

July 26, 2024 • 12:00–1:30 pm PT

Climate and Security Network Panel Event "Evolving toward Resilience: The Climate Security Threat of Wil dfires"

Panelists: LCDR/Dr. Kellen Jones, Dr. Susan Prichard, Honorable Ron Goode, Dr. Daniel Eisenberg, and Dr. Rebecca Miller

Virtual via Zoom. Register at https://www.nps.edu/web/climate-and-security/events

SEPTEMBER

September 16–20, 2024

Critical Energy Infrastructure Protection and Resilience (CEIP) course

Bydgoszcz, Poland

Taught to Ukrainian students at the NATO Joint Force Training Center by the Energy Academic Group and the Center for Infrastructure Defense.

September 30, 2024

Panel on Climate and Energy Security Garmisch Partenkirchen, Germany

EAG will host a panel on climate and energy security at the NPS Alumni event at the George C. Marshall Center.

DECEMBER

December 11, 2024

Refuel (Contested) Logistics Certificate application deadline

For more information, please visit *nps.edu/web/eag/operational-energy-certificate*

UPCOMING

2024 Defense Energy Seminar Series

Watch for upcoming dates and full event details as they become available on the EAG website at ***nps.edu/web/eag/seminars***

EVENT UPDATES

For updates to our calendar, please visit the EAG website and Events tab at ***nps.edu/web/eag/events***

ENERGY ACADEMIC GROUP
NAVAL POSTGRADUATE SCHOOL

Connect with the Energy Academic Group

The Energy Academic Group is located in Suite 537, Spanagel Hall on the NPS campus in Monterey, California. A wide range of NPS faculty are affiliated with the energy program, actively participate in energy graduate education, energy executive education, and energy research. For questions, please contact one of the principal EAG faculty members:

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CLIMATE AND SECURITY
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