SURGE ⚡

ENERGY ACADEMIC GROUP QUARTERLY NEWSLETTER WINTER 2024

ENERGY POLICY

The Changing Geopolitics of Energy: It's Essential for States to Update Their Energy Policies

By Robert F. Cekuta

Energy security is integral to the national security of the United States and to countries around the world. Russia's weaponization of natural gas, the impacts of the war in Ukraine on NATO and other allies and partners, China and India's economic rise, the move to renewables and the resulting expanding demand for rare earths and other critical materials have significantly expanded what the U.S. and other governments need to consider and act upon to ensure their citizens and economies have the energy they need, when they need it, and at a price they can afford.

It is not clear whether governments fully recognize the changes underway in the global energy picture and the impacts of those changes on a country's national security. As a result, governments can fall behind in revising the policies for advancing their energy security, leaving them open to a variety of threats. It is essential Washington and other capitals recognize and take into account this widening spectrum of factors and revise their policies and actions to advance their energy security, and thus their foreign policy and other national security interests. Old thinking and old policies are no longer sufficient.

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The full essay can be viewed here: https://bakudialogues.ada.edu.az/media/2023/10/13/bd-v7-n1-fall-2023_chakuta.pdf

ABOUT THE AUTHOR:

Robert F. Cekuta is Senior Adjunct Professor at the School of International Service of American University. He is a former U.S. Ambassador to Azerbaijan (2015–2018) who, in addition to having held other positions in the U.S. State Department, served as Principal Deputy Assistant Secretary for Energy Resources (2011–2014). The views expressed in this essay are his own.

From the Chair
Dan Nussbaum, Chair of the Energy Academic Group

Much is going on within the Energy Academic Group, some of which you can read in this edition of Surge, and some specifics—energy education offerings, battery workforce development, support to NATO and Ukraine's energy and hybrid warfare capacities, and climate security—I want to call attention to below.

Here is an update on our energy education offerings:

- On our Operational Energy (OE) courses, after a committed 2023, our OE 1 Course is well into the pilot phase of development. After months of curriculum refinement and pilot courses at Ft. Gregg-Adams, VA, and Naval Base San Diego, CA, we will soon be conducting our first pilot of the entire one-week OE 1 Course. From 18-22 March 2024, we will be hosting students and observers in Monterey to participate and assess our offerings in the core aspects of Operational Energy for warfighters. In conjunction with instructors from across the joint OE enterprise and experts from the Massachusetts Institute of Technology's Lincoln Laboratory, EAG will pilot OE 1 in order to gather another round of student feedback. Based on this data, we will spend the next few months refining and honing the OE 1 Course, ensuring it is ready for the fleet. We are planning to ensure OE 1 is ready for our joint E4-E6 and O1-O3 in July, after which we will begin delivery across the Department of the Navy. If you are interested in hosting a week of OE 1 at your installation or unit, please reach out to me or Michael Davis for more information.

- On our distance learning certificates, the Energy Academic Group has created and launched three graduate level asynchronous distance learning certificates. The Operational Energy certificates were developed for mid-level career students focused on three energy areas of expertise. These areas include Unmanned Systems, Directed Energy, and Refuel (Contested) Logistics. Each cohort of 25 students will graduate with NPS certificates planned to be applicable towards a master's degree in Operational Energy. Our next certificate, Refuel Logistics, will be offered again in Spring 2024. For further information, please reach out to me or to Colleen McHenry.

Here is an update on our activities in Climate Security:

- Following up on the previous announcement that "NPS and Stanford's Doerr School of Sustainability have signed an Educational Partnership Agreement (EPA)", I am delighted to note that the NPS-Stanford partnership has launched the Climate Security Fellows Program for the 2023–2024 Academic Year. The Fellows Program enriches graduate student experiences at NPS and Stanford by creating a space to learn about and discuss major issues in climate change, national security, and sustainability. The program facilitates both virtual and in-person learning and networking for the 12 fellows. The first session occurred on 1 December with an introduction to climate science and climate security. The program will run through May and will conclude with presentation of fellows' team projects on a climate security topic of their choosing. For further information, please reach out to me, Kristen Fletcher, or Bill Muras.

- EAG also supports the Navy Decarbonization Research Consortium, a public-private collaboration that advances interdisciplinary research to help the Navy meet the complex challenges of platform decarbonization. The Consortium focuses on the hard-to-decarbonize ships and aircraft and released its roadmap this fall which is available at http://bit.ly/3tWFOae. For further information, please reach out to me or to Kristen Fletcher.

Here is an update on our battery workforce development (BWD) effort:

- The fast pace of the past eight months has brought us to an important juncture in this intense research program focusing on the gaps in battery workforce programs. The work is sponsored by OUSD (Acquisition and Sustainment). In Phase I we investigated all facets of the upstream, midstream, and downstream sectors of the battery supply chain, and we forged connections across the mineral mining and battery manufacturing/recycling industries, as well as across government and academia. We presented the status of the project to the Federal Consortium of Advanced Batteries (FCAB), a consortium of all the federal departments and approximately 80 other stakeholders. Now, the BWD team is preparing to complete Phase I with submission of a strategic roadmap, including proposed courses of action that will close the gaps between battery workforce development programs

currently in existence. Upon DoD's selection of courses of action to pursue, the BWD team will then pivot to serving as an initiator and conduit for the creation of programs that will support and enhance the battery workforce and thereby strengthen national security. For further information, please reach out to me or to Mary Sims.

EAG continues to support HQ NATO in developing Ukraine's Energy and Hybrid Warfare capacities. Now, in support of a potential Ukraine accession to NATO, EAG is supporting the development of courses to support Ukraine's urgent priorities to modernize its decision processes. This includes processes to design, build, and maintain NATO-integratable forces with the ability to withstand future Russian aggression. For further information, please reach out to me.

I am looking forward to the 2024 Naval Operational Energy Forum: 29 January – 2 February 2024, to be held at Naval Surface Warfare Center Carderock Division (NSWCCD). The objectives of the forum are to identify and share near-term naval Operational Energy gaps, priorities, and impacts of naval concepts of operations to align efforts and influence R&D initiatives, prioritize efforts to complement the budget, and inform policy.

I encourage you to reach out to me and to the POCs in this article. We would be happy to hear your ideas.

CONTACT
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ENERGY SECURITY

EAG Co-hosts Black Sea Energy Security Conference in Washington D.C.

By Brenda Shaffer, PhD
Faculty-Associate Research, Energy Academic Group

The Energy Academic Group (EAG) of the U.S. Naval Postgraduate School held a conference November 14, 2023 on energy and security in the Black Sea region in Washington, D.C.. The Atlantic Council's *Atlantic Council in Turkey* co-hosted the conference.

Keynote speakers at the conference included: Assistant Secretary of State, Bureau of Energy Resources, Ambassador Geoffrey R. Pyatt; Chief U.S. Economist and Head of Oil Analysis at BP, Michael Cohen; Magzum Mirzagaliyev, Chairman of the Board of KazMunayGas; and Ambassador of the Republic of Azerbaijan to the United States, Khazar Ibrahim. Türkiye's Minister of Energy and Natural Resources, Dr. Alparslan Bayraktar, delivered keynote remarks virtually.

Ambassador Pyatt and Minister Bayraktar mentioned that this conference kicks-off the US-Türkiye Energy Dialogue, which they hope to formally initiate in early 2024. Several panelists mentioned the threat from Russia's periodic disruption of Kazakhstan's oil exports from the Black Sea, and the dangers of the escalation of the war between Russia and Ukraine that has moved to the maritime domain.

Over the last decade, EAG has held several conferences, multiple trainings and exercises, and conducted research related to the Black Sea region which is a critical area for international security and energy security. The Black Sea region is the meeting ground between NATO and Russia, the Caucasus, the Balkans, Europe, Central Asia, and the Middle East. Developments in this part of the globe affect the security of this entire region. The Black Sea and Türkiye serve also as a major energy transit route. The increased insecurity in the Black Sea, especially with the recent rise in attacks on sea vessels, has resulted in an added premium on the global oil price. Natural gas from the Caspian region transits Türkiye and Georgia to Europe, playing a major role in alleviating Europe's energy security of supply challenges. Trans-Caspian energy and other trade is growing, and some of the new export will reach Europe and world markets via the greater Black Sea.

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Contact Dr. Brenda Shaffer at eag_poc@nps.edu for more information about this event.

COP28: UN Climate Conference Focuses on Finance and Fossil Fuels

By Kristen Fletcher
Faculty Associate-Research,
Energy Academic Group

The 2023 UN Climate Change Conference, known as COP28, took place in November and December in the United Arab Emirates (UAE), and, as the 'Conference of the Parties,' it brought together governments, nongovernmental organizations and the private sector. While many topics were covered at COP28 including climate-induced migration, climate and health, and food security, two areas of focus included finances and fossil fuels.

An early accomplishment at COP28 was the official launch of a fund to pay for loss and damage from climate change. There is no firm obligation for developed countries to pay into the fund; Italy, France, UAE and Germany each pledged at least $100 million while the U.S. pledged $17.5 million. Top contributors to global carbon emissions, India and China, have not yet pledged to the fund. The loss and damage fund is separate from other UN-related climate funds; the U.S. recently announced a multiyear pledge of $3 billion for the Green Climate Fund. This pledge is subject to Congressional authorization.

Notably, more than 200 countries at COP28 agreed to "transition away from fossil fuels." According to a UN Press Release, the agreement "signals the 'beginning of the end' of the fossil fuel era by laying the ground for a swift, just and equitable transition, underpinned by deep emissions cuts and scaled-up finance." While some left COP28 disappointed with a lack of a clear call for fossil-fuel phase out, it is the first time an agreement regarding fossil fuels has been reached in 28 years of international climate negotiations. In another first, the Global Stocktake called for accelerating the deployment of low-emission technologies including significant growth of nuclear energy and renewable energy.

Related to fossil fuels, the Oil and Gas Decarbonisation Charter was signed by 50 fossil-fuel companies and was co-launched with Saudi Arabia. The charter pledges to end gas flaring by 2030, zero-out methane emissions and align with net zero emissions by 2050. Another significant development was Columbia joining the fossil fuel nonproliferation treaty, the first major oil exporter to do so. Finally, Australia and Norway joined the clean energy transition partnership, an initiative with a goal of ending international public finance for fossil fuels.

Leaders from the Department of Defense, along with other U.S. agencies, attended COP28. COP29 will convene in November 2024 in Azerbaijan.

LEARN MORE

Visit the COP28 website at:
https://unfccc.int/cop28

Contact: Kristen Fletcher at
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Does the US Military Have Enough Minerals for a Possible Conflict with China?

Estimating Shortfalls for Military Materials

By Gregory Wischer and Morgan Bazilian

The National Defense Stockpile is a tool to both reduce America's reliance on foreign materials, especially materials from China, and to prepare for a possible conflict. However, the Department of Defense does not publicly release its biennial stockpile assessment, which analyzes what materials may be in shortfall during a conflict. And even if publicly released, the biennial stockpile assessment—if the publicly available 2015 assessment is indicative—does not specifically delineate the military's projected shortfall quantities for individual materials. Material shortfalls can impact—and have impacted—U.S. warfighting ability.

Better understanding the military's projected shortfall quantities for individual materials would inform what materials—and corresponding applications—the U.S. military will most likely have shortfalls of during a conflict. Such information could help optimize what materials are stockpiled. [Author/affiliation] has recently written a paper that provides a simple methodology to estimate the U.S. military's shortfall risks for twenty-three materials in three different conflict scenarios with China. It finds that the following nine materials have the highest shortfall risk: antimony, bismuth, cobalt, niobium (columbium), metallurgical-grade fluorspar, acid-grade fluorspar, iridium, nickel, and titanium sponge.

Moving forward, the Department of Defense (DoD) should consider publicly releasing its biennial stockpile assessment. DoD should also consider releasing information on projected military shortfall quantities for individual materials, as well as information on the U.S. military's annual usage of individual materials. With this information, U.S. policymakers could better understand the military's supply chain risks and pursue risk mitigation policies.

Furthermore, the defense industrial base could preemptively stockpile materials with high shortfall risks before the outbreak of a conflict, enabling the defense industry to better support the war effort.

ABOUT THE AUTHORS

Gregory Wischer is principal at Dei Gratia Minerals, a critical minerals consultancy. He is also a non-resident fellow at the Payne Institute for Public Policy at the Colorado School of Mines. Morgan Bazilian is professor and director of the Payne Institute for Public Policy at the Colorado School of Mines. Formerly, he was lead energy specialist at the World Bank.

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The full paper can be viewed here https://nps.edu/web/eag/estimating-shortfalls-for-military-materials

U.S. Releases Fifth National Climate Assessment

In November 2023, the U.S. released the Fifth National Climate Assessment (NCA5), which presents analysis of climate and global change in the United States. Led by the U.S. Global Change Research Program, the NCA5 underwent a multi-phase process of internal and external review from federal agencies, climate and energy experts, and the public to describe what we know and where uncertainties remain, and to clearly communicate the risks, responses, and opportunities associated with climate change. The NCA5 features physical science chapters including observations and projections of climate change and how methods to understand changes in Earth systems are advancing, national topic chapters including current and future risks related to climate change and what can be done to reduce those risks for a variety of societal and economic sectors of the United States, and regional chapters including region-specific challenges, opportunities, and success stories for managing risks and impacts.

REPORT AVAILABLE ONLINE
Visit https://nca2023.globalchange.gov

Energy Academic Group Partners with NATO and the European Union for COHERENT RESILIENCE 23B

By LtCol Charles B. Lynn, USMC, Ret., Faculty Associate-Research, Energy Academic Group

The Energy Academic Group (EAG), in partnership with NATO's Energy Security Center of Excellence (ENSEC COE) and the European Union's Joint Research Center (JRC), participated in the COHERENT RESILIENCE 23B (CORE23B) Table Top Exercise from 13-17 November 2023.

Held annually, this year's CORE exercise took place in Riga, Latvia, and involved participants from over a dozen nations and more than fifty-four organizations across the diplomatic, informational, military, and economic spectrum. The focus of the exercise was to examine likely conventional and hybrid threats to critical energy infrastructure in the Baltic region, particularly those threats emanating from the maritime environment. This focus area was chosen because the Baltic Sea is home to significant surface and subsurface energy infrastructure, some of which has already been threatened or compromised since Russia's illegal invasion of Ukraine.

During the exercise, participants were organized into four syndicate groups, each representing an area of subject matter expertise. This year's syndicates were Critical Energy Infrastructure Protection, Strategic Communication, Maritime Law, and Crisis Response. Each syndicate worked through a series of scenarios that posed likely threats to the energy infrastructure in the Baltics and surrounding countries. On the last day of the exercise, the individual syndicates briefed their outcomes to senior leaders and other distinguished visitors. The most significant best practices and lessons learned that come out of the exercise will be included in a final exercise report which can serve as a guide for improving international, national, and regional cooperation in the face of growing threats.

Naval Postgraduate School (NPS) faculty, along with Navy Reservists from the Office of Naval Research and one NPS student, comprised the evaluation teams for the exercise. These teams assessed

Participants from over a dozen countries and fifty-four organizations receive opening remarks on Day 1 of the COHERENT RESELIENCE 23B Exercise. This year's exercise focused on developing coordinated responses to conventional and hybrid threats to critical energy infrastructure in the Baltics and surrounding countries.

each syndicate's work and then worked to compile the final exercise report based off their observations and notes. Evaluation team leaders for CORE 23B included Dr. Victor "Bob" Garza, retired U.S. Army Colonel Mike Davis and Dr. Michael Malley from NPS, as well as Mr. Michael Sullivan from the Department of Homeland Security. This year, NPS also provided a syndicate facilitator, Mr. Daniel O'Connor, from the Federal Emergency Management Office.

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Contact LtCol Charles B. Lynn at charles.lynn@nps.edu for more information.

Refuel (Contested) Logistics Certificate Course

The Naval Postgraduate School's (NPS) Energy Academic Group (EAG) is pleased to offer the Operational Energy Certificate: Refuel (Contested) Logistics as part of EAG's Operational Energy Certificates program. Three stackable graduate level certificates have been developed for this program to educate students on the technical, operational, and security aspects of DoD's energy needs.

The Refuel (Contested) Logistics Certificate, curriculum number 121, commences 25 March 2024 in the AY24 Spring Quarter.

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.

ENERGY OUTREACH

Energy Academic Group Participates in KAMANDAG 7 Exercise in the Republic of the Philippines

By LtCol Charles B. Lynn, USMC, Ret., Faculty Associate-Research, Energy Academic Group

Figure 1: Representatives from the Energy Academic Group, the USMC Expeditionary Energy Office, the US Army Corps of Engineers, and the USMC 31st Marine Expeditionary Unit meet with the Technical Manager of the Batanes Electrical Cooperative in Basco, Philippines

The Energy Academic Group (EAG), in partnership with the Marine Corp's Expeditionary Energy Office (E2O), the 31st Marine Expeditionary Unit, and the U.S. Army Corps of Engineers traveled to Basco, Philippines, from 22-30 October 2023 as part of exercise KAMANDAG 7, a multi-lateral, joint exercise conducted annually in the Philippines.

The municipality of Basco is the provincial capital for Batanes Province, the northernmost province of the Philippines. Part of the Batanes island chain, Basco is strategically located in the Luzon Strait, sitting roughly 200 nautical miles from both Luzon and Taiwan. In addition to its operational relevance, its location also makes the island chain a frequent target of typhoons and earthquakes, causing extensive damage to its energy systems and other critical infrastructure.

As part of a larger, multi-disciplinary team, EAG Faculty Associate Charles Lynn participated in numerous site visits and key leader engagements to assess vulnerabilities of the energy and water system in the Batanes islands. Engagements included a luncheon with the Provincial Governor, the Honorable Marilou Cayco, meetings with the director of the National Power Corporation (Batanes), the technical director of the Batanes Electrical Cooperative, and the director of the Batanes Disaster Risk Reduction Management Office.

The group also conducted preliminary planning for an energy-related Table Top Exercise (TTX) that will address systemic risks and enhance the ability of national, regional, and local officials to mitigate those risks prior to an emergency. The TTX will include participants from the Naval Postgraduate School faculty, local stakeholders in Basco, and members of the U.S. and Philippines Marine Corps. It is slated to take place as part of the BALIKATAN exercise in the Spring of 2024.

LEARN MORE

Contact LtCol Charles B. Lynn at **charles.lynn@nps.edu** for more information.

Join the Energy Team

EAG is looking for a motivated person to join our curriculum development team in Monterey to work on the energy challenges affecting the U.S. military and national security. We are seeking entry level or early mid-level experience. The minimum education requirement is a bachelor's degree. Areas of interest include instructional design/development, batteries, supply chain/logistics, workforce development, operational energy, or policy/geopolitics of energy. This position will remain open until filled.

LEARN MORE

To explore the short and long-term opportunities available, contact Mary Sims at **mjsims@nps.edu** or go to HERC at **https://main.hercjobs.org/jobs/19333732/faculty-associate-research**

Wind Turbine Power Analysis for Microgrid Design Planning

By LT Gaby Smith, United States Navy and LT Leo Jofre, Chilean Navy

Microgrids have been the focus of recent Department of Defense investments as a means to increase energy resilience in military installations. Additionally, there is a strong drive to integrate renewable energy sources such as solar power and wind power within microgrids to reduce reliance on fossil fuels and reduce greenhouse gas emissions. To support ongoing research focused on the integration of renewable energy sources, an student team at the Naval Postgraduate School (NPS) has developed a physics-based model developed to predict the energy output of commercial wind turbines. This tool will be used to aid in the preliminary planning stages of microgrid design by analyzing the potential of different types of wind turbines. The methodology involves four main steps: 1) developing a mathematical model based on wind speed and wind turbine parameters to calculate the electrical power produced; 2) collecting real-world wind data from a location (Monterey in this case) on a man-portable microgrid wind turbine to use as inputs; 3) compiling a database of wind turbine specifications from multiple sources; and 4) implementing the model and wind data in MATLAB to estimate the power output as a function of time for a selected wind turbine. Figure 1 shows the process by which students designed the wind power model for wind turbines. Figure 2 shows a plot of wind simulated for one iteration. Figure 3 shows a plot of wind energy produced with 10 iterations. This tool will aid base energy managers in planning the design of microgrids for their bases to ensure they achieve the goal of increasing energy resilience and reducing fossil fuel consumption. In the future, the tool will be integrated into the microgrid web tool (**https://microgrid.nps.edu**) that NPS students and faculty have been developing over the last several years.

LT Jofré *LT Smith*

ABOUT THE AUTHORS
LT Jofré is in the Chilean Navy and is pursuing a Master of Science in Systems Engineering. He will graduate from the Naval Postgraduate School in June 2024. LT Smith, USN, is pursuing a Master of Science in Systems Engineering. She will graduate from the Naval Postgraduate School in June 2024. Contact Prof. Douglas Van Bossuyt at **douglas.vanbossuyt@nps.edu** for more information about this research.
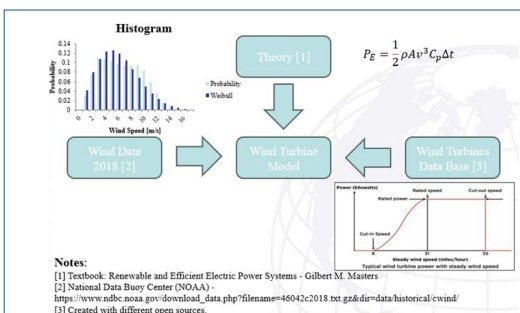
Figure 1: Wind Turbine Model Development Process.
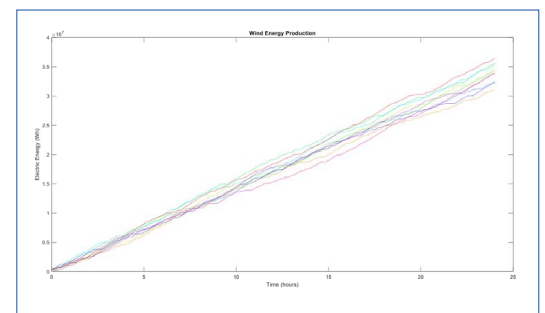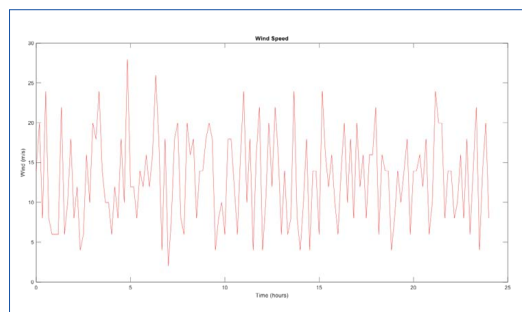

Figure 2: Wind simulated with one iteration.

Figure 3: Electrical energy simulated with 10 iterations.

A Machine Learning Approach to Study the Resilience of Fuel Systems

By LT Vincent Wickel, German Army

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 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
Lieutenant Wickel graduated from the Universität der Bundeswehr München in December 2023 with a Master of Science in Cybersecurity. His thesis was written at the Naval Postgraduate School (NPS) in cooperation with the EAG and the NPS Institute for Infrastructure Defense. Contact Prof. Nussbaum at **danussba@nps.edu** for more information about this research and cooperation program.

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

Strengthening Ukraine's Resilience

By Tahmina Karimova, Faculty Associate-Research, Energy Academic Group

The Russo-Ukrainian war has demonstrated that critical infrastructure is one of Ukraine's most vital and vulnerable assets. Aggressor's ongoing kinetic and non-kinetic attacks against the country's critical energy infrastructure (CEI) are resulting in lasting ramifications not only for Ukraine but the region itself. As such CEI protection is instrumental in enhancing national stability and resilience, especially in times of war.

The Naval Postgraduate School (NPS) executed the NATO Critical Energy Infrastructure Protection and Resilience Course (CEIP&R) from 23-27 October 2023 in Poland. Thirty military and civilian personnel from diverse Ukrainian organizations as well as Polish and Lithuanian personnel attended the course. The five-day program was conducted in partnership with the NATO School Oberammergau and was hosted by the Lithuanian-Polish-Ukrainian Brigade in Lublin, Poland. The course was executed in close collaboration with the NPS' Energy Academic Group (EAG) and Center for Infrastructure Defense (CID) as well as NATO HQ, NATO Energy Security Center of Excellence, and NATO Ukraine Liaison Office.

The course aimed at equipping civilian and military personnel of Ukraine with knowledge and skills on CEIP&R to enhance resilience and ultimately support the development of CEIP guidelines for Ukrainian national authorities. The 5-day course was meticulously designed to provide a critical mix of theory and practice, with presentations ranging from strategic/geopolitical to operational and applied.

In particular, CID leads, Drs. David Alderson and Daniel Eisenberg, presented best practices for vulnerability and resilience analysis of critical energy infrastructure and led hands-on activities and serious gameplay to demonstrate concepts in action. By the end of the week-long instruction, participants were able to apply vulnerability and resilience concepts for real infrastructure systems that mattered to their organizations, including power grids, dams, and telecommunications systems.

The course was well received, as noted by EAG Associate Chair, Mr. Alan Howard. The program serves as a critical platform for sharing lessons learned and best practices, collaborating, and tackling issues of critical strategic importance between NPS, allies, and partners. Stakeholders are planning a follow-on course next fall to continue enhancing Ukraine's ability to strengthen energy security and CEI resilience.

LEARN MORE

Contact Tahmina Karimova at ttkarimo@nps.edu for more information about this event.

Defense Energy Certificate Awardees

Dr. Dan Nussbaum and the Energy Academic Group (EAG) congratulate graduates from the first Cohort of NPS' Unmanned Systems Persistence Certificate and acknowledge their hard work and dedication to the program. Upon conclusion of the fall quarter, certificates were conferred to 16 students. Feedback indicates that the program is a worth-while and "eye-opening" experience, with a practical application to address DoD needs. For complete enrollment information, please contact Dr. Colleen McHenry at colleen.mchenry@nps.edu.

Corey Bergsrud (CIV) Crane
Indiana · NSWC Crane

Christian F. Bowers (CIV)
Washington DC · NAVFAC EXWC

Captain Corey M. Bredeson, USMC
Quantico, VA · Combat Development and Integration

Roberto I. Guerrero (CIV)
Washington DC · HQ USAF

Eric Hahn (CIV)
San Diego, CA · Naval Post Graduate School

Richard P. Hardy (CIV)
West Bethesda, MD · Naval Sea Systems Command NV2 4

Evan M. Headley (CIV)
Philadelphia, PA · NSWCPD

Peter F. McCauley (CIV)
Washington DC · NAVSEA

Arch W. McCleskey (CIV)
Washington · Navy Yard Naval Sea Systems Command

Samuel L. Parsons (CIV)
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Michael C. Robinson (CIV)
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Jesse L. Shepard (CIV)
Washington DC · NAVSEA

Jacob Sontag (CIV)
Washington DC · NAVSEA

Matthew E. Wiegner (CIV)
Philadelphia, PA · NSWCPD

Sustainable Drop-in Fuels Necessary to Decarbonize DoN Ships and Aircraft

By Cayle Bradley, Faculty Associate-Research, Energy Academic Group

In FY22 researchers with the Naval Postgraduate School's (NPS) Energy Academic Group (EAG) and Systems Engineering department assessed potential pathways to reach net-zero naval operations by 2050. The study quantified Department of the Navy (DoN) operational systems' emissions and generalized illustrative pathways.

In FY23 a follow-on analysis was performed to further quantify measures that would best support global climate change mitigation efforts and net-zero objectives. The study cited reported climate science and assessed the impact of four specific pathways: alternative force structure, advanced nuclear energy, platform carbon capture and storage, and sustainable fuels. The analysis assumed the DoN would not accept measures that would reduce operational capabilities and would not significantly depart from existing logistics and sustainment concepts.

The study concludes that alternative force structure concepts like unmanned systems could realize some emissions reductions by 2050, but the future force will likely add these advanced concepts to the planned force architecture, and therefore increase operational energy demand. Advances in nuclear energy and non-drop-in alternative fuels like ammonia and methanol could enable some future capabilities but will not likely proliferate to scale to support 2050 targets. And although maritime platform carbon capture technologies are advancing commercially, the power demand and CO2 storage requirements of maritime carbon capture will likely preclude commissioned warships and naval aircraft.

The study deduced that by 2050 platforms currently in operation and those planned over the next two decades will continue to employ conventional gas turbine and diesel engines demanding up to 28 million barrels of aircraft and marine diesel fuels, as shown in Figure 1. Only sustainable drop-in fuels (sustainable F-76 and JP-5) offer potential to significantly reduce emissions on naval ships and aircraft by 2050.

Researchers with the EAG are now coordinating with DoN energy offices and with the Department of Energy to message the requirement for drop-in JP-5 and F-76 for consideration in DOE funded development of sustainable fuels production processes.

LEARN MORE

Find the full report: Analysis of Pathways to Reach Net Zero Naval Operations by 2050, Phase II
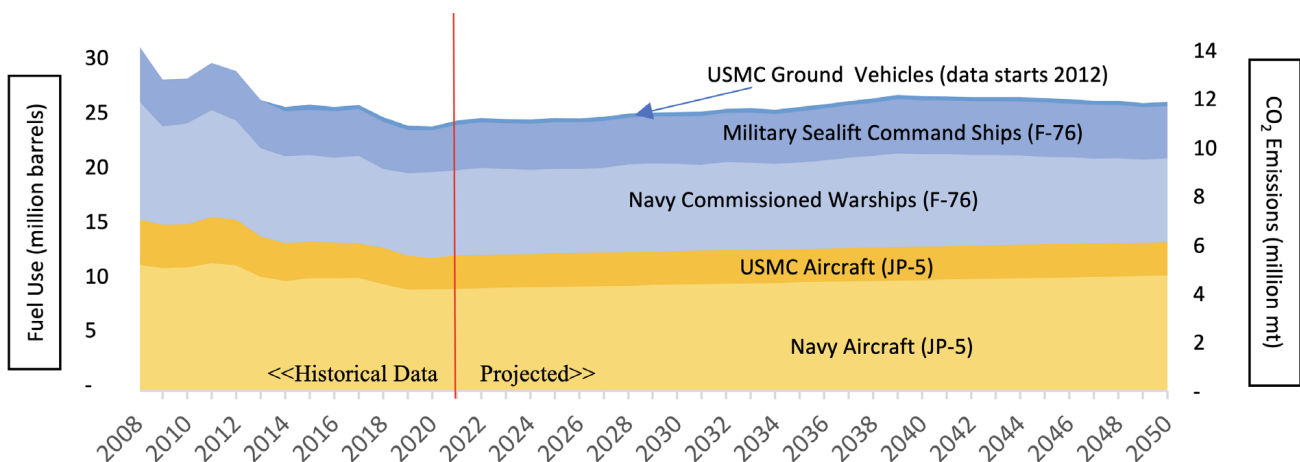
Contact Cayle Bradley at cayle.a.bradley@nps.edu

Figure 1: Historical fuel use as reported in the Naval Visibility and Management of Operating and Support Costs (VAMOSC) Management Information System. Projected figures based on 30 Year Shipbuilding Plan and the CNO's Navigation Plan 2022. Combustion of JP-5 and F-76 release approximately 410 and 420 kg of CO2 respectively.

📅 Calendar of Events and Important Dates

JAN

January 29 – February 1, 2024
Partnership Training and Education Centres Working Group 2024
Brasov, Romania

FEB

February 12 – 16, 2024
Energy Security Strategic Awareness course
Oberammergau, Germany

February 26 – 28, 2024
The Alliance of the Future
www.zeihan.com
Monterey, California

MAR

March 12 – 14, 2024
NATO Tabletop Exercise Coherent Resilience 2024
Chisinau, Moldova

March 18 – 22, 2024
Operational Level Energy Security Course
Tartu, Estonia

UPCOMING

2024 Defense Energy Seminar Series
EAG is pleased to have resumed in-person presentations for its Defense Energy Seminar lecture 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 Room 101A, 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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✏️ Contribute to an issue of *Surge*

If you would like to contribute an article or have your research/work published in the *Surge* newsletter, please contact Lois Hazard via email at **lkhazard@nps.edu.**

Surge is published quarterly by the Energy Academic Group at the Naval Postgraduate School.

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