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SURGE Newsletter Fall 2019

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Monterey, California. Naval Postgraduate School

SURGE

ENERGY ACADEMIC GROUP QUARTERLY NEWSLETTER FALL 2019

Highlights

ENERGY OUTREACH

EAG Co-sponsors Regional Energy Security Symposiums in Tbilisi, Georgia and Baku, Azerbaijan

Recently appointed U.S. Ambassador to Azerbaijan, Lee Litzenberger used the symposium in Baku to deliver his first major public remarks on energy.

The Energy Academic Group co-sponsored two Regional Energy Security Symposium Caucasus events this year. The first was held in Tbilisi, Georgia from 15–19 April 2019 and was hosted by the Levan Mikeladze Diplomatic and Research Institute of the Ministry of Foreign Affairs of Georgia. The second event was an advanced program held in Baku, Azerbaijan from 1–5 July 2019, which was hosted by the government's diplomatic academy, ADA University as well as oil executives from British Petroleum (BP) and the State Oil Company of the Azerbaijan Republic (SOCAR); both companies are key stakeholders in the region's critical energy infrastructure, and were therefore key participants in the discussion. Participants included government and industry representatives from Turkey, Georgia, and Azerbaijan. Lecturers included academia, government officials, as well as oil executives from BP and SOCAR.

The objective of the symposiums was to further energy security and resiliency through increased awareness, information sharing, interagency collaboration, and regional cooperation. Both weeklong events included several topics such as energy security, geopolitics, threats to energy infrastructure, and critical infrastructure protection and resilience. Breakout groups were formed for each event in order to allow energy security stakeholders to focus detailed discussions on energy crises such as cyberattacks, terrorism, and hybrid warfare. The advanced program provided information regarding energy research, as well as robust sessions on cyber security and critical energy infrastructure protection. Most of the participants for the advanced program attended either the Tbilisi event in April or participated in the July 2018 symposium in Baku.

NPS faculty from the Energy Academic Group and the Center for Infrastructure Defense provided briefings on energy security, critical energy infrastructure protection and resilience, threats to energy infrastructure, and cases studies, as well as facilitated daily breakout groups.

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Email Lawrence Walzer at **lmwalzer1@nps.edu** or call 831-656-3777

Principal's Thoughts

Dan Nussbaum, Principal, Energy Academic Group

My purpose is to introduce you to one of NPS' strategic thrusts and how the Energy Academic Group (EAG) directly supports this thrust through Distance-Learning (DL) educational opportunities.

NPS' Strategic Plan has three themes: Excellence and Innovation in Emerging Fields Critical to National Defense; Interdisciplinary Education and Research Programs; and Institutional Innovation and Effectiveness. Similarly, EAG has three Pillars: Curricula, Research, and Outreach. Within the Curricula pillar, our DL Defense Energy certificate program supports NPS' Interdisciplinary Theme by taking an interdisciplinary approach, with courses in physics, electrical and computer engineering, national security studies, and operations research. Our sponsors are the Office of the Secretary of Defense (OSD) and the Office of the Chief of Naval Operations (OPNAV), and the objective is to provide those working military and civilian employees of DoD the opportunity to understand the complex issues facing the Operational and Installation Energy segments of DoD. This Certificate program is designed to expose students to the interdisciplinary, technical, operational, and security aspects of DoD energy needs. All courses are offered asynchronously, via web-based media on a schedule of one course per quarter for four quarters, and all courses are taught by regular NPS faculty. I encourage you to take a look at this program to see if it fits the needs of your office and colleagues. As always, we are open to suggestions on how to make it better and how to more directly address your needs in this vital area. You can always send comments to me or to Kevin Maher at kjmaher@nps.edu

I want to welcome Professor Karen Flack, from the Mechanical and Engineering (ME) Department at the U.S. Naval Academy (USNA). Karen is the former Chair of the USNA ME Department, and she's coming to NPS to spend her sabbatical year working with NPS' EAG and ME Department. We are honored to have her here, and we look forward to many research and thesis opportunities with her, as well as the opportunity to strengthen ties with our sister naval academic institution.

Let us hear from you.

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Defense Energy Seminar Series

NPS' academic programs in Defense Energy are supplemented by a seminar series which provides a forum for leading voices within the field, practitioners, and other Defense Energy influencers. These professionals give presentations, engage in brown bag discussions, and facilitate informal gatherings that encourage Defense Energy faculty and students to discourse over current issues in Defense Energy, supplementing classroom teaching with practical, professional experiences. The Defense Energy Seminars Series is a permanent part of NPS' Defense Energy program, and a key to its real-world relevance.

LEARN MORE
Please see the Calendar of Events in this issue of ***Surge*** or visit **nps.edu/web/eag/seminars** for upcoming and archived seminars.

Geopolitical energy expert and author Peter Zeihan presents at the Defense Energy Seminar held in July 2019.

ENERGY EDUCATION

EAG Supports NATO Tabletop Exercise Coherent Resilience 2019 in Vilnius, Lithuania

108 participants from 14 countries participated in the three-day event.

From 15–19 May 2019, the Energy Academic Group (EAG) supported the NATO Tabletop Exercise Coherent Resilience (CORE) 2019 in Vilnius, Lithuania in cooperation with the NATO Energy Security Centre of Excellence (ENSEC COE) and the Joint Research Centre (JRC) of the European Commission. The main objective of the event was to test and evaluate the resiliency of gas supply in the Baltic Sea region.

The exercise was conducted at the ENSEC COE's location aboard the premises of the Military Academy of Lithuania. 108 participants from 14 countries participated in the three-day event. The EAG supported the event from concept development through the execution of the exercise with a main role of supporting the evaluation process.

The focus of the scenario and exercise vignettes/injects was centered on potential regional hybrid threats. In addition to taking a comprehensive approach towards improving resilience of regional gas supply systems and infrastructure, the program was designed to further strengthen cooperation among regional countries to best avoid or mitigate potential gas supply reductions in the future.

The three-day event included an academic seminar, the tabletop exercise, and an after action/distinguished visitor day. The academic seminar included presentations on regional natural gas networks, EU regulations, public-private partnerships, and cyber security challenges. The preponderance of the three-day event was the tabletop exercise, where four syndicates responded to dynamic regional atmospherics and incidents related to impacts on gas supply that required analysis, coordination, and planned responses.

The EAG sent a multi-disciplinary team including faculty, students, and U.S. naval reserve officers to support CORE 2019. In addition to the EAG, NPS faculty from the School of Business and Public Policy, the Electrical & Computer Engineering Department, and the Center for Cyber Warfare also supported the event. As well, two students from the NPS National Security Affairs program participated. For the third consecutive NATO CORE exercise, the Mission Capable, Persistent and Survivable Naval Platforms (Code 33) Department of the Office of Naval Research supported the event with several officers with unique specialties and backgrounds.

The EAG supported the event from concept development through the execution of the exercise with a main role of supporting the evaluation process.

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Email Lawrence Walzer at **lmwalzer1@nps.edu** or call 831-656-3777

STUDENT ENERGY RESEARCH SPOTLIGHT

Distributed Energy Storage Design and Modeling to Improve the Energy Security of Naval Facilities

by LTJG Petros Siritoglou

Energy security for naval facilities is of strategic importance. Energy security is characterized by the ability to supply critical loads reliably, indefinitely, economically, and in an environmentally friendly manner (sustainably), which enables full-time mission support.

Combining renewable resources and, specifically, the emerging technology of photovoltaics (PV) with a battery storage system is considered a proven approach to providing energy security and serves as the basis of this research.

Most design tools available focus on the design of grid-tied or hybrid renewable power systems. The development of a user-friendly design tool for accurately sizing a stand-alone power system to meet the critical load demands of a naval, commercial/industrial, or even a residential facility is presented in this research. The tool complies with both Institute of Electrical and Electronics Engineers (IEEE) Standards 1562 and 1013. In addition to these guidelines, the developed tool considers important factors that both standards should address in their future revisions.

Several case studies, which were simulated using a Simulink model based on the outputs of the design program, validate the design software. Finally, we successfully conducted 24-hour laboratory experiments, the results of which confirmed the simulations as well as the accuracy of the sizing methodology; this is a feature that many sizing programs lack.

Main screen of the sizing program developed in Matlab.

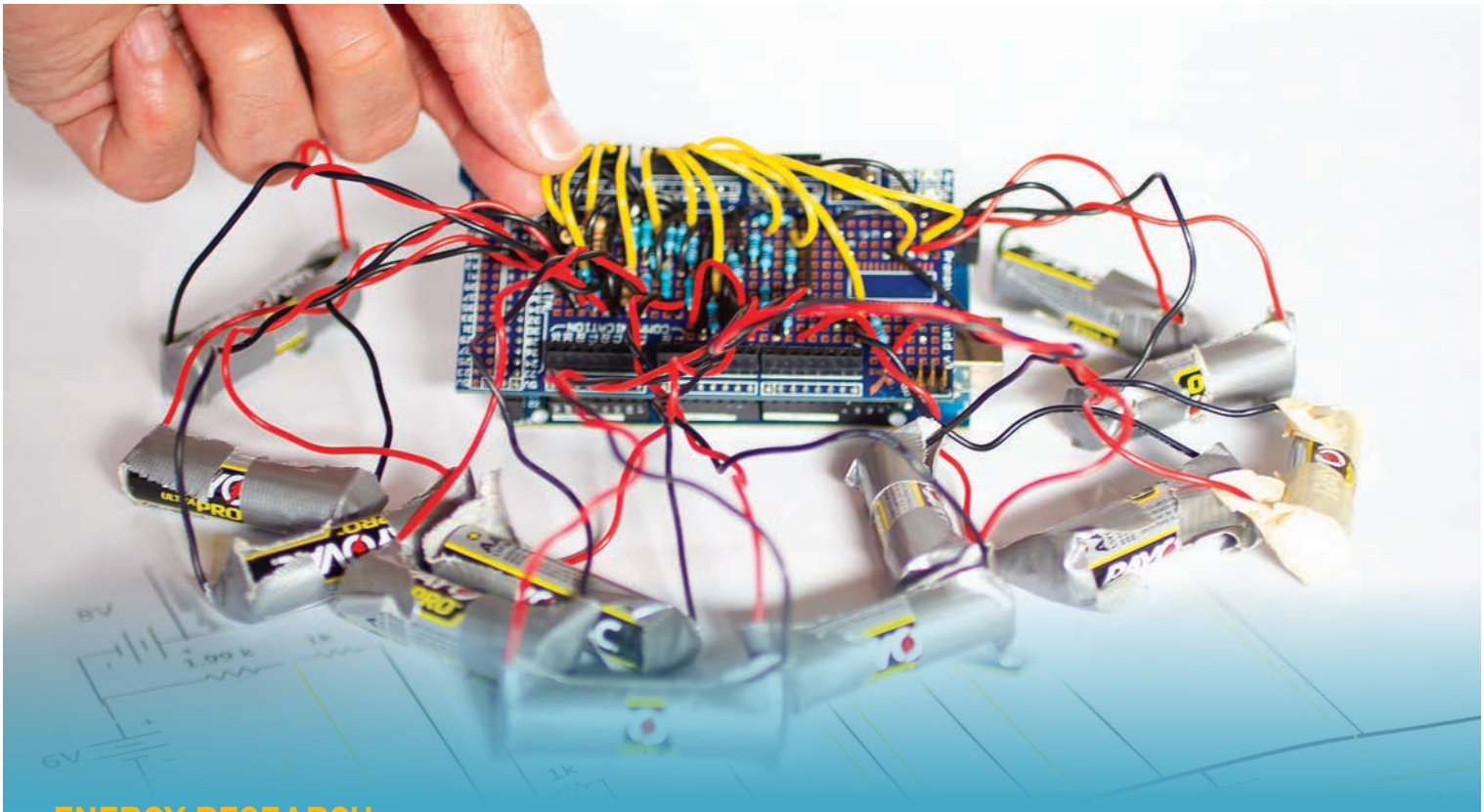
Setup of the PV panels at the Naval Postgraduate School.

Laboratory experiment setup.

LTJG Petros Siritoglou

About the author

LTJG Petros Siritoglou is a Greek naval officer and a student in the Electrical Engineering Department of the Naval Postgraduate School. Contact Dr. Giovanna Oriti at **goriti@nps.edu** for more information about this research.



ENERGY RESEARCH

EAG Hosts Summer Interns at NPS

Battery bank voltage measurement system prototype which supports research and educational efforts at NPS and will likely be adapted for use in future graduate-level theses or research projects.

This summer the Energy Academic Group at the Naval Postgraduate School (NPS) hosted a team of three interns from Salinas, California based Hartnell College's Community College Catalyst program to support microgrid and operational fuel modeling projects. This program allowed the interns to gain real world experience working on technical problems to enhance their development as undergrad engineering students while supporting naval research.

"This internship provided me a glimpse of the engineering career which I want to pursue. It gave me valuable exposure to the field and showed me what a professional environment is like, helping me refine my own professional skills."

— Ruben B., Student at Hartnell College

The interns were tasked with two projects, updating an existing surface fleet fuel consumption model to serve as an educational tool in an operational logistics course, and assisting in the design, component selection, and programming of a hybrid containerized microgrid system. In the surface fleet fuel consumption model, the team focused on debugging existing code and writing documentation to make the program easier to use and understand. In the microgrid project, the interns identified Commercial Off-The-Shelf (COTS) components that could be assembled into a functioning microgrid system and developed a prototype data collection device to monitor the system's battery bank and allow for basic controls. Both of these projects support research and educational efforts at NPS and will likely be adapted for use in future graduate-level theses or research projects.

LEARN MORE

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OPERATIONAL ENERGY

Bringing Defense Planning Into the 21st Century Through Modern Software

By Corrie Poland, Air Force Operational Energy (SAF/IEN)

U.S. Air Force photo by Staff Sgt. Michael Ki Hong

You wake up and check your smart phone for the latest weather and news of the day. As you roll out of bed, your phone tells you the best route to work based on up-to-date traffic patterns and congestion. Pulling out of your driveway, the gas light blinks on, and you ask your phone to reroute you to the closest gas station on your way to work. Your estimated time to work adjusts accordingly. Along the road, your side mirror lights up as passing cars speed by, letting you know there's someone in your blind spot. The GPS directs you to take the next exit in 1000 feet, and you begin turning off the highway. As you pull into the parking lot, your car app reads a coworker's text to you over the stereo and advises you to park in the rear due to construction. Once you've parked, you seamlessly switch to your smart watch to respond and head into the office.

For many Americans, this scenario is a familiar part of our routines. Yet, for much of the defense community the ease and functionality of modern technology is not translated to military planning systems. While cumbersome acquisitions processes, funding issues, and security concerns are often valid causes, many Department of Defense processes (and any software associated with them) cannot compete with the technology many Americans use regularly. In one corner the U.S. Air Force flies the most advanced aircraft in the world, yet in the other corner, Airmen use clunky spreadsheets and paper documents to analyze operations and mission plan.

As technology evolves exponentially for our day-to-day lives, the Department of Defense has historically struggled to keep up with the latest software and innovation. In a 2018 address to Airmen, Former Secretary of the Air Force Heather Wilson stated, "In a world where far more innovation is happening outside the government than inside of it, connecting to that broader scientific enterprise is absolutely vital to our future."

"Sharpening our competitive edge in this new age will require creative approaches, innovation, resources and execution at the speed of relevance," Wilson continued. "The advantage will go to those who create the best technologies and who integrate and field them in creative operational ways that provide military advantages."

> **"In a world where far more innovation is happening outside the government than inside of it, connecting to that broader scientific enterprise is absolutely vital to our future."**
>
> – Heather Wilson, Former, Secretary of the Air Force

A little over a year later in April 2019, the Air Force published a new Science and Technology Strategy, encouraging

Airmen to once again push beyond the status quo and build an "Air Force that dominates time, space, and complexity in future conflict across all operating domains to project power and defend the homeland." The strategy lays out three main objectives: (1) Develop and Deliver Transformational Strategic Capabilities, (2) Reform the Way Science and Technology Is Led and Managed, and (3) Deepen and Expand the Scientific and Technical Enterprise.

While organizations and initiatives such as AFWERX, Spark Tank, and Defense Innovation Unit, among others, provide a solid base for relaunching this effort, a culture of innovation is brewing below the surface among smaller offices and units.

For example, as part of its vision to increase combat capability through optimized aviation fuel use, Air Force Operational Energy (SAF/IEN) discovered mission planners were using spreadsheets and email chains to design critical fuel logistics operational plans.

"Our current primary means of planning is by Excel modeling to answer a specific question. These models require constant cleansing of data, manual input into the model, and then management of the model as data changes," said operational energy planner Derek Reid, based out of Pacific Air Force Headquarters at Joint Base Pearl Harbor-Hickam. Further complicating matters, is the burden of distributing updates to the spreadsheet model, which often requires planners to email the spreadsheet back and forth and then look for updates.

This realization prompted the office to lead and fund the development of a fuel logistics software that enables mission planners to automatically calculate (and securely share) the demand of petroleum, oil, and lubricants (POL) at operating locations, while determining optimal routing (and replenishment) of POL to defense fuel storage terminals. Using the Joint Operational Energy Modeling System (JOEMS) capability, this innovative visual tool—scheduled to launch in 2019—will be critical to detecting possible gaps in fuel availability—and therefore capability—more quickly and accurately.

Tools like Jigsaw, a tanker planning software for aerial refueling (and its forthcoming update, Pythagoras, which will enable autonomous planning) and Magellan, a tanker allocation and planning software, are other examples of how the Air Force is streamlining mission planning using modern software. Future Air Force Operational Energy initiatives include incorporating these planning tools into wargaming to help Airmen 'practice the way they play'. "We're excited to be a part of how the Air Force is becoming more innovative and modern," said Mike "Pappy" Penland, Principal Director of Air Force Operational Energy. "Our Airmen deserve tools and resources that will make their lives easier so they can focus on the mission at hand."

The call for smarter, faster, and more innovative technology is ringing throughout the Pentagon hallways, and one by one, DoD offices are picking up.

LEARN MORE

For more information on energy optimization efforts in the Air Force, visit: **safie.hq.af.mil/OpEnergy**

ENERGY EDUCATION

EAG Partners with NATO to conduct Energy Efficiency in Military Operations Course

From 20–24 May 2019, the Naval Postgraduate School's Energy Academic Group (EAG) partnered with the NATO Energy Security Center of Excellence to execute NATO's Energy Efficiency in Military Operations Course in Vilnius, Lithuania. This course is conducted annually with the purpose of raising awareness and knowledge regarding the importance of seeking energy efficiency in the military domain, particularly, during military operations.

A soldier from the United Kingdom briefs his breakout group's responses to an energy efficiency wargame created and facilitated by EAG faculty.

Mr. Brandon Naylor, a mechanical engineer with the EAG faculty, was the lead for the development, presentation, and execution of an energy efficiency wargame that focused on best practices, emerging technologies, and alternative energy solutions related to expeditionary base camp power. The exercise challenged student work groups with scenarios and problems requiring the development of solutions and enabled a competitive environment for groups to compete for the most fuel-efficient plans.

Over twenty participants from across NATO ally and partner nations attended the program. Attendees highlighted the importance of sharing and learning best practices related to energy efficiency in military operations in order to further the operational reach and lethality of our forces. A sample of course topics included: energy security, energy efficiency in NATO, initiatives for energy resilience, energy metering, battery storage options, energy modeling, hybrid/renewable energy solutions, and energy management best practices.

The next EEMOC will be in Vilnius, Lithuania in May 2020.

LEARN MORE

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Calendar of Events

OCT

October 22, 2019
Defense Energy Seminar Series with Dr. Brenda Shaffer
Visiting Researcher at Georgetown University's Center for Eurasian, Russian, and East European Studies (CERES) and Senior Fellow at the Atlantic Council's Global Energy Center.

October 24, 2019
2019 Energy Action Month Expo
Washington Headquarters Services' Environmental, Sustainability, and Energy Branch (ESEB) will hold the second annual Energy Action Month Expo at the Pentagon. The Energy Academic Group will attend as an exhibitor and will showcase NPS energy research, initiatives, and programs.

October 29, 2019
Defense Energy Seminar Series
Guest speaker to be announced.

NOV

November 12, 2019
Defense Energy Seminar Series with Professor Nicholas Dew
Graduate School of Business and Public Policy, Naval Postgraduate School

November 19, 2019
Defense Energy Seminar Series
Guest speaker to be announced.

DEC

December 3, 2019
Defense Energy Seminar Series
Guest speaker to be announced.

December 10, 2019
Defense Energy Seminar Series
Guest speaker to be announced.

Interested in Energy-Related Thesis Research?

Over the past five years, NPS and the EAG supported a plethora of student thesis research in the area of energy. A compilation of abstracts on student theses and other research is available on the EAG website: **nps.edu/energy.** 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!

ENERGY ACADEMIC GROUP
NAVAL POSTGRADUATE SCHOOL

Connect with the Energy Academic Group

The Energy Academic Group is located in Quarters D, Bldg 281 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.

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