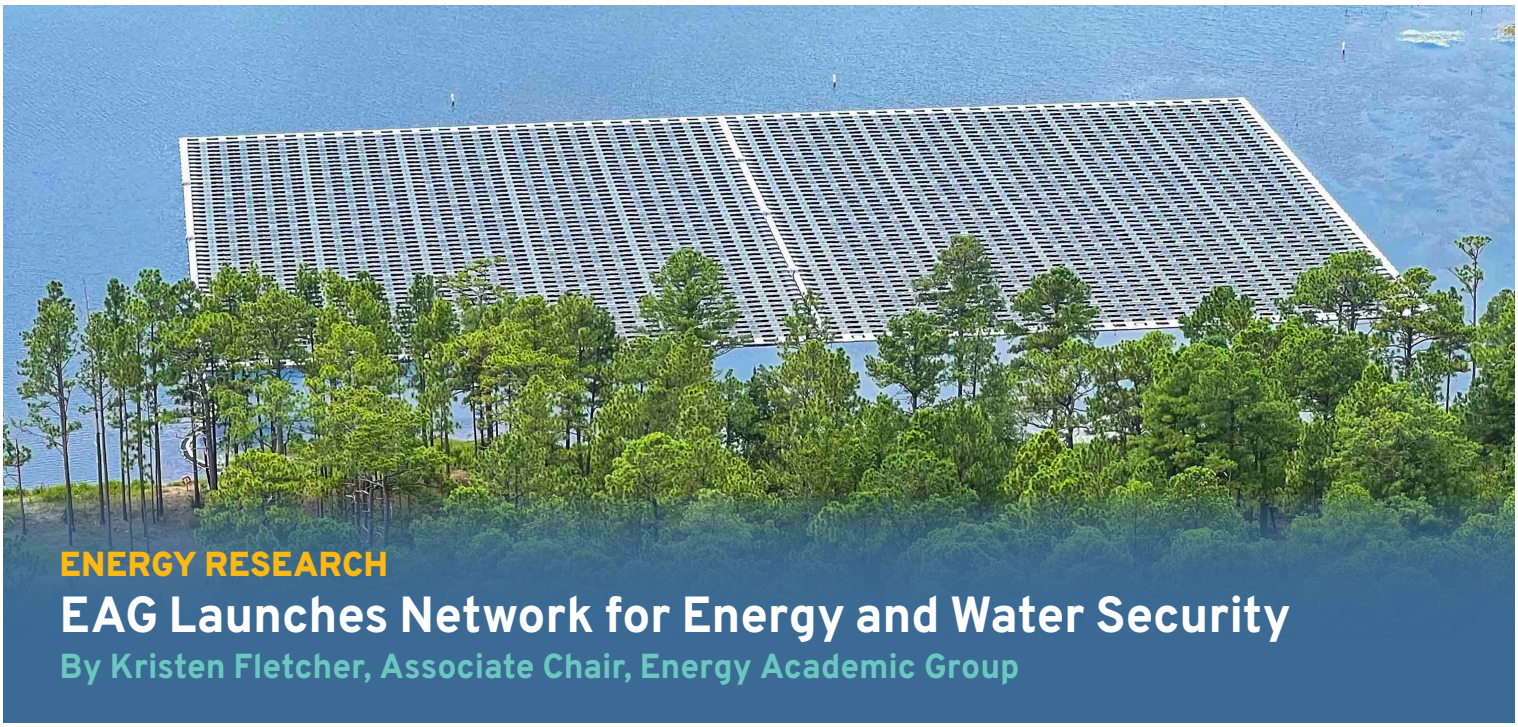
SURGE

ENERGY ACADEMIC GROUP QUARTERLY NEWSLETTER WINTER 2026

Highlights



ENERGY RESEARCH

EAG Launches Network for Energy and Water Security

By Kristen Fletcher, Associate Chair, Energy Academic Group

Floating solar microgrid at Fort Liberty, North Carolina (U.S. Army/Jason Ragucci)

In September, the Energy Academic Group (EAG) launched the Network for Energy & Water Security (NEWS), which brings together civilian and military members of the Department of War and partners from other military and security sectors to learn, collaborate, and develop resilient solutions focused on energy security and water security. The goal of NEWS is to grow a proactive group of security professionals better equipped to address the challenges posed by energy and water insecurity and work together toward secure and resilient solutions.

Participants have access to regular briefings given by government, private sector, and academic partners, a biweekly email update on current topics in energy and water security, and opportunities for partner and network exchanges through in-person and virtual settings.

A key feature of the Network is connecting colleagues who work on these issues and sharing information, perspectives, and expertise throughout the Network. The Network's first set of information requests, submitted by the Global Water Security Center at the University of Alabama, was to quantify (1) water consumption per amount of energy generated by different fuel types and (2) water consumption and energy use by data centers. Network members shared numerous resources, which serve as the start of the Network's online resource library.

The Network is open to military staff, officers, and civilians across the U.S. federal government who support operations, strategic decision-making, and/or research regarding energy security and water security. The Network is also open to partners from within the U.S. and allied nations, although select events and information-sharing may be for a U.S. or U.S. government-only audience.

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To join the Network or for more information, email Kristen Fletcher at **kristen.fletcher@nps.edu**

From the Chair

Alan Howard, Chair, Energy Academic Group

This issue of *SURGE* arrives at a moment when the military significance of energy is once again unmistakable. As record freezing temperatures grip Europe, Russia's continued, deliberate attacks on Ukraine's energy infrastructure underscore how energy systems are both operational enablers and strategic targets in modern warfare. By degrading an adversary's ability to generate power, move forces, sustain operations, and defend its population, attacks on energy infrastructure weaken not only military capacity but also societal resilience and will. The resulting humanitarian impacts—millions left without reliable heat and power—are not incidental; they are part of the strategic calculus. Together, these conditions serve as a stark reminder that energy is life-sustaining, warfighting-critical, and inseparable from operational success.

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The articles in this quarter's issue reflect that reality across multiple levels of analysis and action.

Kristen Fletcher's piece on the launch of the Network for Energy and Water Security highlights the growing need for collaboration across government, academia, and partner nations to address energy and water insecurity as shared challenges. The Network is designed not just to exchange ideas, but to connect practitioners who are grappling with real operational and policy questions today.

Major Chase Pedron's analysis of installation energy resilience brings the problem home. His work underscores that the homeland is no longer a sanctuary and that our installations—so critical to force projection—remain vulnerable to grid disruptions, physical attack, and policy blind spots. His proposed interim solutions are pragmatic, actionable, and grounded in operational reality.

William "Bill" Muras's article on thermal energy networks looks forward, examining how emerging infrastructure approaches can enhance resilience, reduce dependence on outside-the-fence energy, and improve mission assurance at military installations. As the Services explore new pathways for resilient energy systems, this work helps translate concept into practice.

Finally, Major Kati Kettunen's research on modeling operational energy at the tactical level reminds us that energy is not just an infrastructure or sustainment issue—it is an operational variable. Her work provides tools that allow planners to visualize and quantify energy tradeoffs in ways that directly inform decision-making.

Taken together, these contributions reinforce a simple but powerful point: energy is not ancillary to military operations—it is foundational. Whether at the tactical edge, on our installations, or across allied and partner networks, the ability to plan for, protect, and operate through energy disruption is central to readiness and resilience.

As always, I am proud of the breadth and relevance of the work coming out of the Energy Academic Group. I hope this issue of *SURGE* prompts continued dialogue, collaboration, and—most importantly—action.

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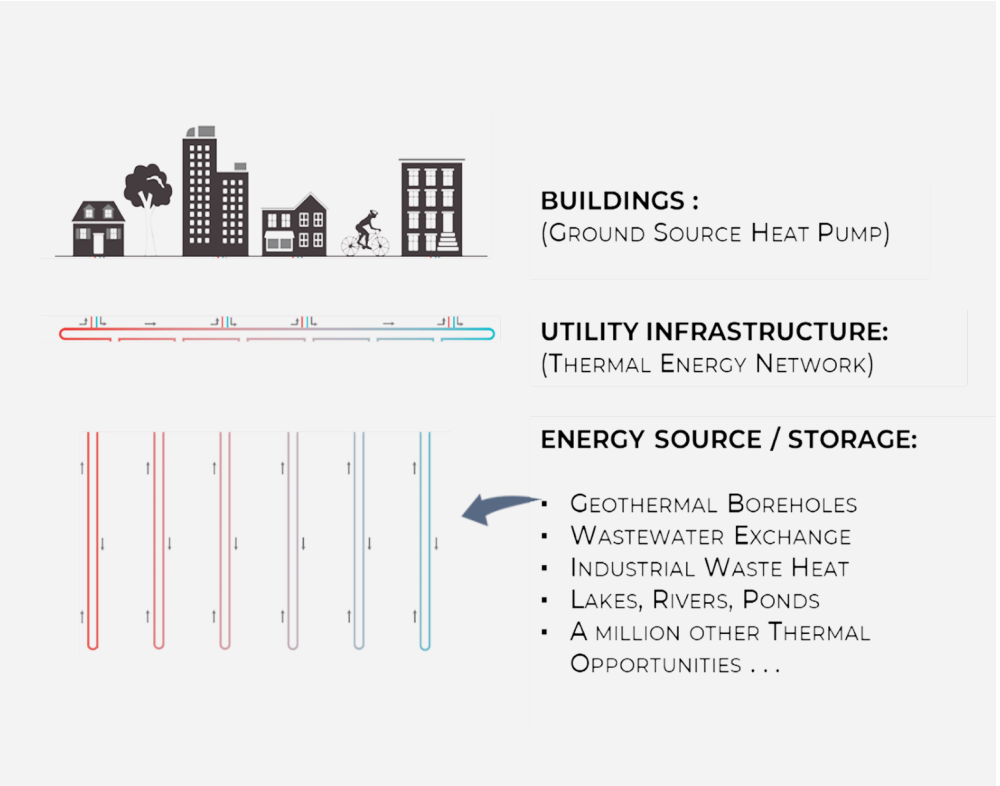
ENERGY SECURITY

Thermal Energy Networks: Enhancing Installation Energy Resilience and Security

**By Bill Muras,
Faculty Associate-Research,
Energy Academic Group**

The Environmental Security Technology Certification Program (ESTCP) demonstrates and validates novel technologies at military installations in operational settings to document and validate improved performance and cost savings.

The Energy & Water focus area of ESTCP is currently funding multiple feasibility and design studies across the Services to evaluate the technical and economic performance of thermal energy networks to improve the energy resilience and security of military installations.



Generic thermal energy network depiction (Source: HEET)

Technology Description

Thermal energy networks (TENs) (also known as 5th generation district energy systems, geothermal networks, thermal microgrids, or networked geothermal) come in many different configurations and serve to efficiently provide resilient heating and cooling services to a district, campus, or network of buildings. Core components of a TEN include a system of distributed building-level water-source heat pumps, a shared network of pipes and pumps to distribute the ambient or near-ambient temperature working fluid, and a central plant and/or thermal energy resources to help control the system loop temperature. Low-temperature operation enables efficient operation of distributed heat pumps and allows utilization of the stable temperature of the earth, lower-grade waste heat, and other thermal resources. In addition, individual buildings can be either a provider or consumer (a "prosumer") of thermal energy to the network, based upon the individual needs of each building at any given time.

In the illustration (above), the thermal energy network includes a geothermal borehole array as a thermal source/sink to moderate the thermal network's temperature, although many other configurations are possible.

Potential Benefits

With a focus on increasing energy security and resilience, these systems offer multiple potential benefits for military installations, which are being researched, analyzed, and quantified through ESTCP-funded efforts. Some of these benefits include the following.

- The reduction of imported energy, which lowers the reliance on "outside the fenceline" energy sources.
- Energy savings, peak demand reduction, load shifting and cost avoidance of additional electric infrastructure investments.
- Lower operations and maintenance costs and a reduction in the requirements of on-site back-up generation.
- The opportunity to leverage external financing through Utility Privatization, Energy Savings Performance Contracts and/or Utility Energy Service Contracts.

EAG will share information and results as the feasibility and design studies progress in 2026 and beyond.

LEARN MORE

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ENERGY RESILIENCE

Bridging the Power Gap: Installation Energy Resilience in a Contested Homeland

By MAJ Chase Pedron, U.S. Army, MS Candidate, Defense Analysis Department, Naval Postgraduate School

The Department of War (DoW) relies on the operational readiness of its installations to generate combat power. However, this readiness is critically endangered by a growing capability gap: the inability of installations to ensure operational continuity when the civilian electrical grid is disrupted. While long-term initiatives, such as the Janus Program, microgrids, and small modular reactors (SMRs), are promising, they remain years away from complete implementation. Installations require pragmatic, cost-effective interim solutions, such as the four options proposed below, to mitigate these vulnerabilities now.

The Core Problem: Unreliable Power Provision

U.S. military installations are almost entirely dependent on an antiquated and increasingly insufficient civilian power grid. Over 99% of bases depend on electricity from local utilities, yet the U.S. power transmission infrastructure is unreliable. It struggles to adapt to surging demand from energy-intensive technologies and the variable nature of renewable energy sources.
This reliance creates a critical vulnerability to both natural disasters and malicious actors. The risk is not theoretical. Malicious physical attacks on substations in California, North Carolina, and the Pacific Northwest, alongside frequent weather-driven outages, demonstrate how easily large-scale power loss can occur. Furthermore, the Cybersecurity and Infrastructure Security Agency (CISA) has warned that adversaries, particularly the People's Republic of China, are already positioned in U.S. critical infrastructure to launch destructive cyber-attacks to impede military readiness.

Structural Barriers to Resilience

Case studies of division-level installations, such as Fort Carson and Fort Campbell, highlight how systemic challenges in policy and resource allocation create a difficult environment for maintaining energy security. While installation teams are dedicated to maintaining operational continuity, they are often constrained by foundational infrastructure and regulatory limitations, as seen in the following examples.

- Fuel Storage Constraints: There are existing infrastructure limits regarding on-site diesel fuel reserves. For example, some locations maintain supplies sufficient to power backup generators for as little as 24 to 48 hours without external resupply.
- Operational Readiness Testing: Mandatory Black Start exercises provide invaluable data and reveal the immense difficulty of sustaining power to key locations beyond a three-day window given current resource levels.
- Regulatory Definitions: Current federal policy, including the National Defense Authorization Act of FY 2021, specifies that "critical mission" designations do not include military housing, dining facilities, or commissaries.
- Life Support Vulnerabilities: Because policy-driven resource allocation focuses on a narrow set of assets, installation leaders face significant

hurdles in mitigating risks, such as food spoilage, sanitation disruptions, or the needs of Exceptional Family Member Program (EFMP) members who rely on medical devices.

Findings and Recommendations: Four Interim Solutions

To bridge the gap until robust microgrids leverage existing resources through four low-cost strategies.

1. Implement "Pigtail" Connections: Installations should install standardized "pigtail" connection points and transfer switches on Tier II priority buildings. This increases flexibility to move existing trailer-mounted, portable generators to the highest points of need around the base. A commander would be able to initially prioritize force deployment facilities, and then shift mobile power to support residential BLS after units have departed.
2. Updating Mission Essential Vulnerable Asset Policies: The DoW must reevaluate narrow operational lenses that exclude sustainment infrastructure. Policies must be updated to designate cold storage, dining facilities, water pumps, and wastewater elevators as mission-essential. Treating BLS as a critical requirement ensures that energy resilience becomes an enforceable doctrine rather than discretionary.
3. Activating "Island Mode" Capabilities: Currently, many on-base energy assets, such as solar arrays and peak shaving generators, must remain offline during a grid outage to prevent dangerous electrical backflow. Installations must pursue contractual and physical modifications to allow these systems to disconnect from the local grid and power the base independently under exigent circumstances. Islanding would enable commanders to tap into existing renewable and diesel generation to support operational continuity.
4. Hardening Physical Infrastructure: Many vital generators and substations on U.S. installations are currently protected chain-link fences or, often, by nothing at all. As demonstrated by Russian attacks on Ukrainian infrastructure, such assets are highly vulnerable to small arms fire and the rising threat of small unmanned aerial systems (UAS). Commanders can better protect existing electrical infrastructure with physical walls and overhead fencing.

Conclusion: A Call for Coordinated Action

The homeland is no longer a sanctuary. The fragile domestic grid, compounded by asymmetric threats, has transformed energy resilience from a logistical hurdle into a national security risk. While awaiting long-term projects, it is important that commanders and policymakers implement these interim measures. By leveraging existing resources and adjusting policy focus, the DoW can close the capability gap and ensure that our installations remain operational to project forces globally even.

LEARN MORE

For more information, contact Major Chase Pedron at **chase.pedron@nps.edu** or **chase.a.pedron.mil@army.mil**.

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

Modeling Operational Energy at the Tactical Level

By MAJ Kati Kettunen, The Finnish Defence Forces, MS Candidate in Defense Logistics Management, Naval Postgraduate School

Understanding energy requirements is important to advance successful tactical missions. This thesis develops a practical approach to understanding how a notional tactical ground unit produces, converts, and consumes energy over a 24-hour period. Using open-source data, the research constructs a linear programming (LP) model that helps illustrate how energy supports operational capabilities. Although the model is developed for a notional unit, the framework can be adapted to real data from actual units.

Energy relationships are first illustrated in a conceptual diagram (Figure 1 below) showing how different energy sources support tactical capabilities. The conceptual model is then refined to represent the notional unit in greater detail. These energy flows are translated into an LP model that quantifies energy production, conversion, and consumption, with all energy forms converted to kilowatt-hours (Figure 2 on page 7).

The LP model is intentionally small and workable in Microsoft Excel, making it accessible for use with classified data.

Its objective function minimizes fuel consumption for electricity production, allowing planners to examine tradeoffs between energy sources. To visualize the results, the study employs Sankey diagrams that clearly depict energy flows within the unit.

Several scenarios demonstrate how energy demand shifts under different equipment mixes and mission conditions, highlighting how changes at the tactical level can significantly affect overall energy requirements.

MAJ Kati Kettunen, The Finnish Defence Forces

LEARN MORE

For more information about this research, contact MAJ Kati Kettunen at **kati.kettunen@mil.fi**

The thesis will be available on Calhoun, **https://calhoun.nps.edu/**

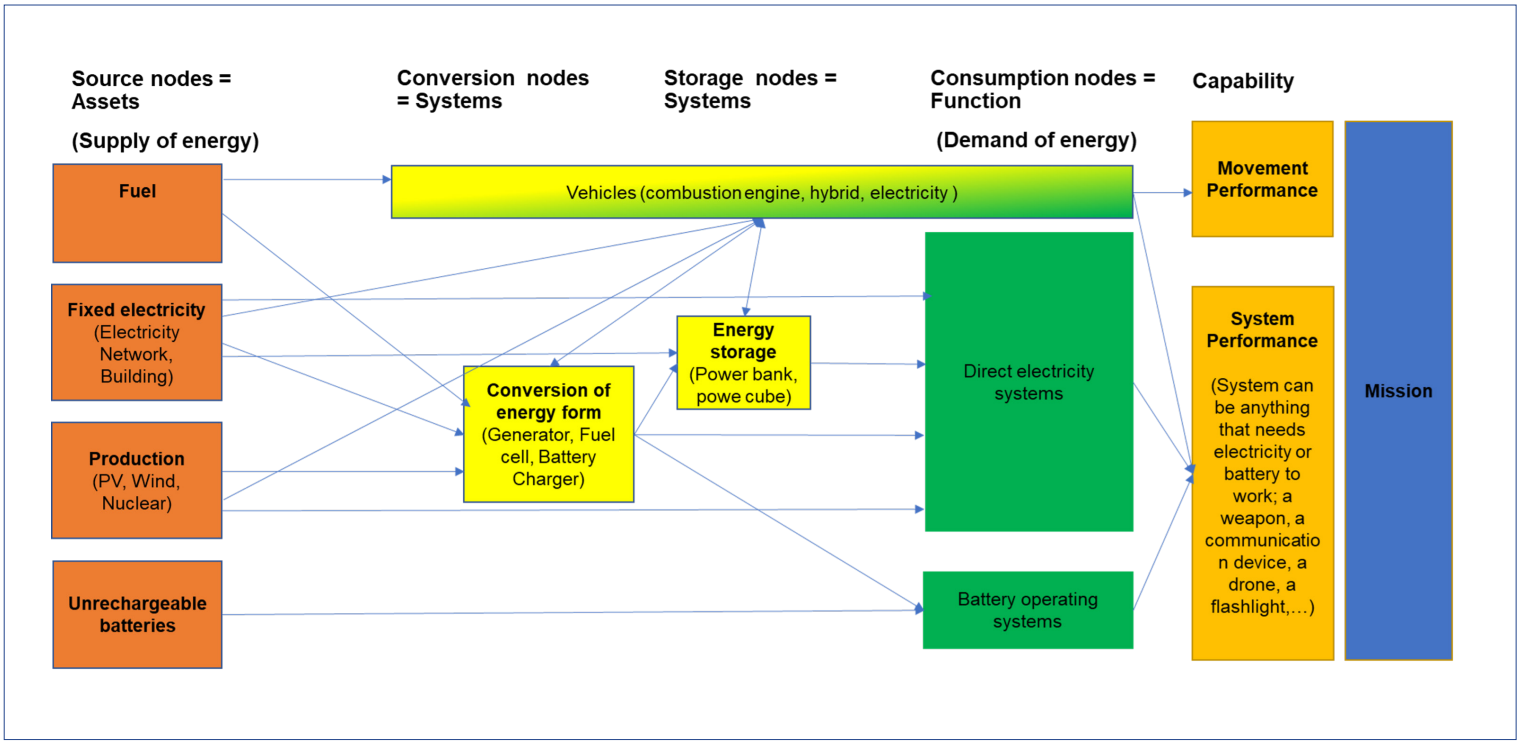

Figure 1. Conceptual model of operational energy in a tactical-level ground unit. This diagram shows the interrelationship and dependencies between energy forms. Note that the results (Orange) are Movement Performance and System performance. Image created by Author.

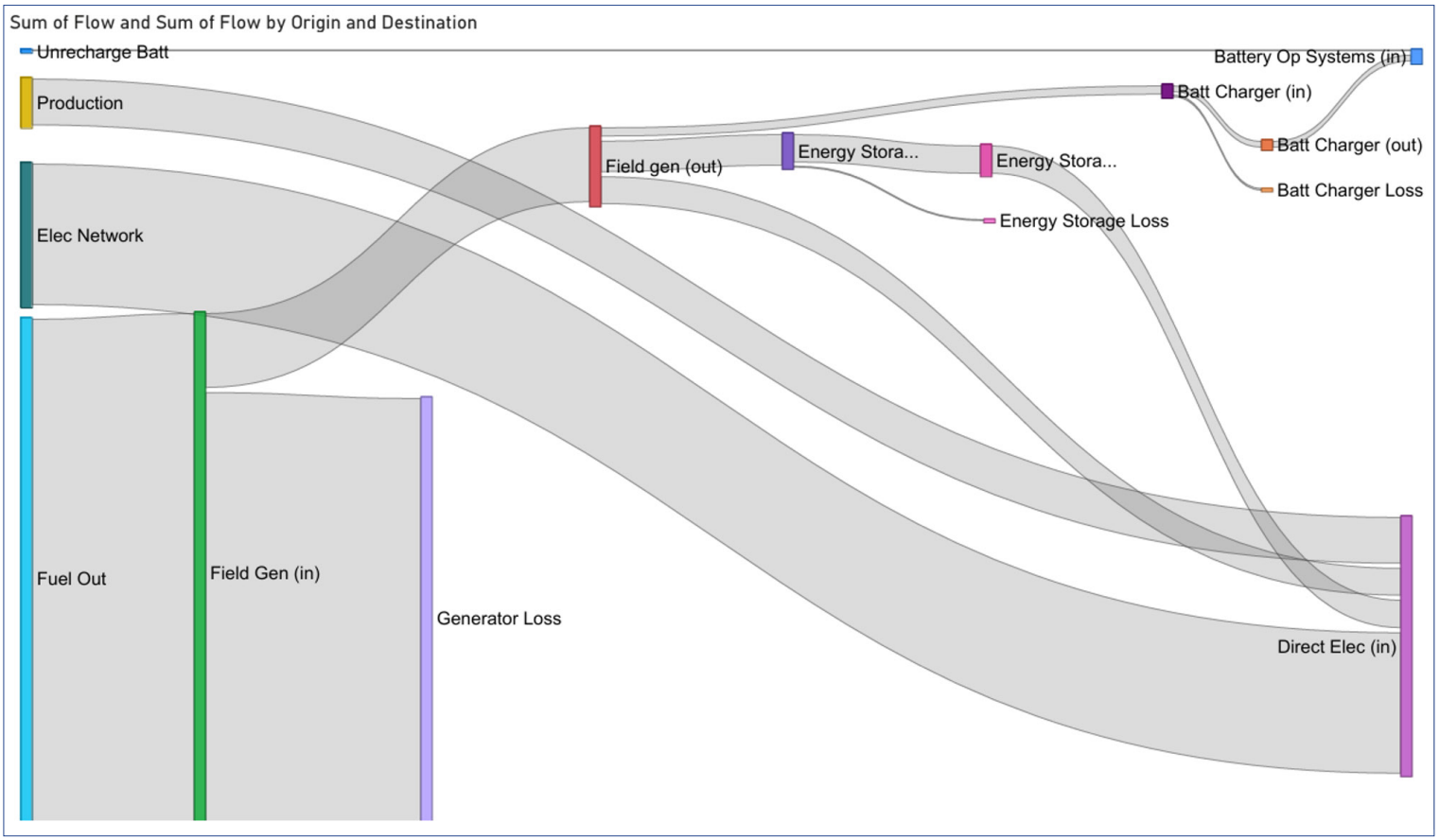

Figure 2. Notional unit's basic scenario energy flows in a Sankey Chart without fuel for vehicles. The electricity and battery flows are clearly visible when the dominance of fuel is removed. Image created by Author.

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 visit **nps.edu/web/eag/seminars** for upcoming and archived seminars.

Calendar of Events and Important Dates

KEY ACADEMIC DATES FOR STACKABLE CERTIFICATES AND THE MASTER'S IN OPERATIONAL ENERGY

Winter Quarter

- Begins: Monday, 5 January
- Last Day of Classes: Wednesday, 18 March
- Graduation: Friday, 27 March

MARCH

09 – 13 March 2026
BALTDEFCOL Operational Level Energy Security Course, Baltic Defence College
*Learn more at **https://www.baltdefcol.org/education/operational-level-energy-security-course***

18 March 2026
Combined Naval Address on Energy & Environment: Contested by Nature: Using METOC to Balance Risk & Capability in Naval Planning
*Contact Kristen Fletcher at **kristen.fletcher@nps.edu** for more information.*

MAY

18 – 22 May 2026
Energy Efficiency in Military Operations Course, Hosted by the NATO Energy Security Centre of Excellence, Vilnius, Lithuania

*Learn more at **https://www.enseccoe.org/courses/energy-efficiency-in-military-operations-course-eemoc/***

UPCOMING

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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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 Keyston Braxton via email at **keyston.braxton.ctr@nps.edu.**

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