

The Directed Energy Professional Society: Accelerating Directed Energy Integration, Workforce Development, and Warfighter Capability in an Era of Rapidly Emerging Threats

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Abstract

Directed energy (DE) technologies are moving rapidly from laboratory research into operational military capability. Advances in high-energy lasers (HEL) and high-power microwave (HPM) systems, combined with growing demand for counter-unmanned aerial systems (C-UAS), integrated air and missile defense, electromagnetic warfare, and force protection capabilities, have elevated directed energy from a niche technical field to a strategic defense priority.

As these systems mature, the challenge is no longer limited to advancing the physics and engineering behind the technology. The larger issue is how to accelerate operational transition across a highly fragmented enterprise involving government laboratories, acquisition organizations, operational commands, industry, academia, and policymakers. Directed energy capability development now depends as much on collaboration, workforce development, operational integration, and professional education as it does on technology itself.

The Directed Energy Professional Society (DEPS) has become the central professional organization supporting this broader ecosystem. As a technically credible and vendor-neutral society, DEPS provides the forums, educational programs, professional networks, and outreach infrastructure needed to connect researchers, developers, operators, acquisition professionals, and the next generation of scientists and engineers entering the field.

This paper examines the growing operational relevance of directed energy systems, and the role DEPS plays in supporting collaboration, workforce development, operational integration, and strategic engagement across the directed energy community. It also discusses why organizations like DEPS are becoming increasingly important as directed energy transitions from experimental technology to operational warfighting capability.

Introduction: Directed Energy and the Changing Character of Warfare

Directed energy has been a major focus of defense research for decades, with annual investments averaging roughly \$1 billion over the last ten years. Early efforts centered primarily on scientific feasibility—power generation, beam control, lethality studies, and laboratory experimentation. While those investments produced major advances in laser and high-power microwave technologies, operational implementation remained limited by immature subsystems, integration challenges, insufficient power and thermal management, and an incomplete understanding of how these systems would perform in realistic combat environments.

That picture has changed considerably over the last two decades.

A convergence of technological maturity and rapidly evolving battlefield threats has pushed directed energy much closer to operational relevance. Improvements in solid-state laser efficiency, adaptive optics, thermal management, beam control, pulsed power systems, modeling and simulation, and target lethality understanding have significantly accelerated development. At the same time, military forces are increasingly confronting low-cost drones, cruise missiles, loitering munitions, and highly contested electromagnetic environments that strain conventional defensive architectures.

The Department of Defense's FY2027 budget request reflects this shift, with directed energy research, development, testing, and evaluation funding exceeding \$1.5 billion—more than a 50 percent increase over FY2026 levels.

Traditional kinetic systems remain indispensable, but they face growing pressure from unfavorable cost-exchange ratios, limited magazine depth, and sustainment challenges when defending against large numbers of inexpensive threats. Directed energy systems offer a different operational model. High-energy lasers provide precision engagement, scalable effects, speed-of-light response, and potentially deep defensive magazines. Laser beam directors can also function as highly capable optical sensing systems when not employed as weapons. High-power microwave systems offer broad-area, non-kinetic options for disrupting or degrading electronically dependent threats, particularly drone swarms and other low-cost autonomous systems.

But technology alone will not determine whether directed energy succeeds operationally.

These systems are inherently multidisciplinary and operationally complex. Their effectiveness depends on target characteristics, atmospheric conditions, thermal management, electromagnetic interactions, platform integration, battle management architectures, and tactics development. Successfully fielding directed energy capability therefore requires sustained coordination across a broad and highly specialized community.

That community includes researchers, operators, acquisition professionals, systems engineers, test organizations, industry partners, educators, analysts, policymakers, and many others. Over the last 27 years, the Directed Energy Professional Society has emerged as one of the most important organizations connecting those groups together.

This paper examines both the strategic importance of directed energy systems and the growing need for integration across the directed energy enterprise. It also explores the role DEPS plays in advancing collaboration, workforce development, operational understanding, and strategic engagement as directed energy moves toward broader military adoption.

DEPS and the Need for Community Integration

The Directed Energy Professional Society was established in 1999 to improve communication, education, and professional collaboration across the directed energy community. Organized as a nonprofit scientific and educational organization, DEPS has grown into the leading professional society focused specifically on directed energy technologies and operational applications.

A major reason the organization has been successful is its credibility and neutrality. DEPS does not represent a single military service, laboratory, or contractor. That independence allows it to function as a

trusted environment where stakeholders can engage candidly on technical and operational challenges without institutional barriers dominating the discussion.

Before DEPS existed, much of the directed energy community operated in isolated pockets. Programs were frequently compartmented, highly classified, or separated by service-specific stovepipes. Significant expertise existed throughout government laboratories, industry, and academia, but opportunities for consistent cross-community engagement were limited.

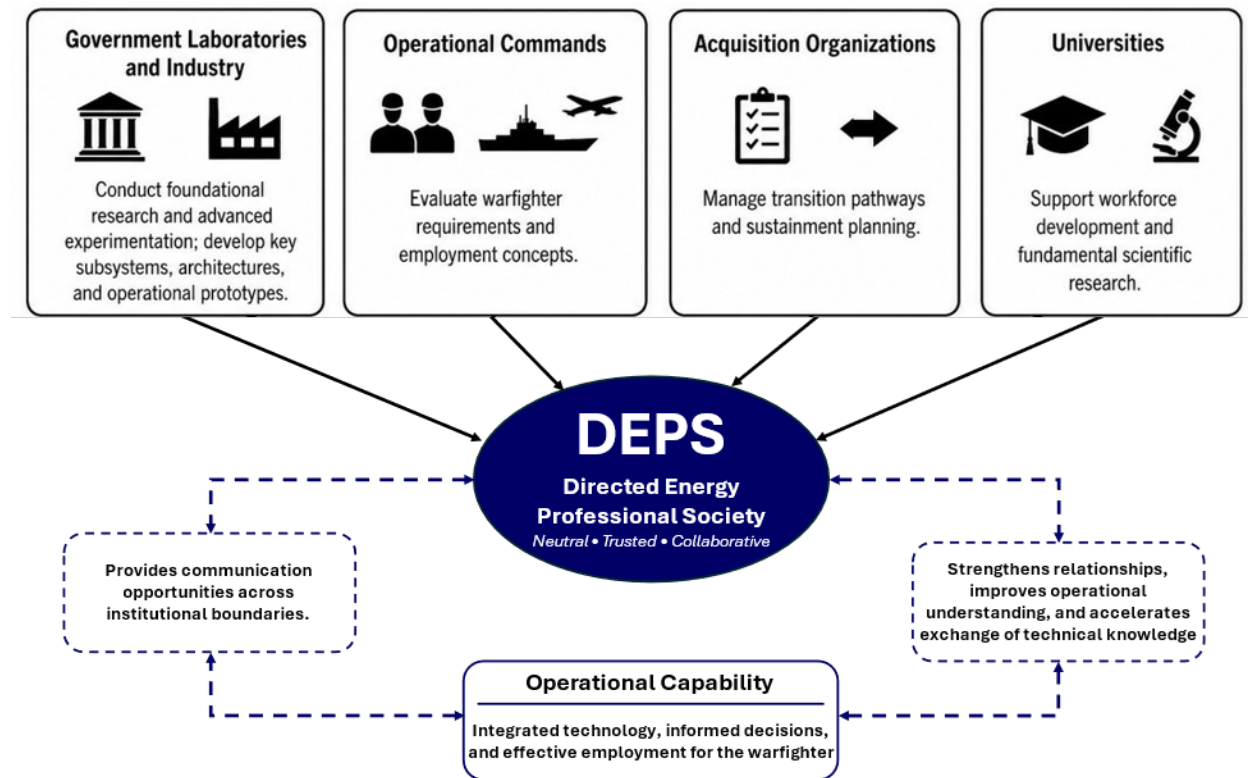


Figure 1 DEPS as a Collaborative Enabler Across the Directed Energy Enterprise

As shown in Figure 1, DEPS helps increase collaboration and breakdown programmatic stovepipes.

The organization established recurring forums ranging from open technical meetings to Controlled Unclassified Information (CUI) and classified exchanges that brought together government laboratories, operational commands, industry, academia, acquisition organizations, and allied partners. DEPS also supported classified bilateral U.S.-U.K. technical exchanges focused on high-energy laser and high-power RF systems under government-directed collaboration efforts.

This type of trusted environment is especially important in directed energy because many of the most operationally relevant lessons—lethality performance, atmospheric effects, beam control limitations, countermeasures, survivability, and integration challenges—cannot be meaningfully discussed in traditional open academic settings.

The organization’s conferences, workshops, technical exchanges, and educational programs create opportunities for interactions that might otherwise never occur. Those relationships matter. In many cases, operational integration advances because the right people are able to communicate early, share lessons learned, and maintain long-term professional trust across organizations.

As directed energy systems have matured, the importance of these collaborative environments has grown substantially.

Today, the directed energy enterprise spans government laboratories, operational commands, defense industry, universities, test organizations, modeling and simulation communities, and acquisition agencies. Each plays a critical role, but they often operate within different institutional cultures and priorities. Without sustained communication, capability development can quickly become fragmented again.

DEPS serves as the primary mechanism preventing that fragmentation.

The transition of directed energy into operational capability depends heavily on the strength of those relationships.

Advancing Collaboration Across the HEL and HPM Communities

Although the high-energy laser and high-power microwave communities involve different scientific disciplines, they face many of the same operational challenges. Both must address issues involving systems integration, power management, testing methodologies, modeling and simulation, sustainment planning, operational employment concepts, and battle management integration.

DEPS remains one of the few places where those communities routinely interact.

That interaction is becoming increasingly important because future defense architectures will almost certainly integrate HEL and HPM systems alongside kinetic interceptors, electronic warfare capabilities, AI-enabled battle management tools, sensors, and C6ISR networks as critical components of offensive and defensive kill chains.

The value of these exchanges works in both directions.

Researchers gain exposure to operational realities that may not be obvious inside laboratory environments. Operators and acquisition professionals gain a clearer understanding of technical capabilities and limitations, developmental timelines, and emerging opportunities. Those discussions help align research priorities with actual warfighter requirements rather than theoretical assumptions.

Conversations surrounding counter-UAS operations, maritime defense, and integrated air and missile defense often produce some of the most valuable insights. Discussions about engagement timelines, atmospheric effects, recent battlefield observations, or systems integration constraints frequently reshape how both operators and developers think about future capability needs.

DEPS also provides important forums for discussions involving lethality characterization, operational testing, modeling and simulation, and tactical decision-support concepts. While the organization does not directly conduct those activities, it creates the environment where the organizations responsible for them can collaborate effectively.

As future battlefields become more compressed, networked, and data-intensive, this collaboration will only become more important. Directed energy systems will need to operate as part of larger, integrated defensive architectures responding to large numbers of coordinated threats under increasingly short decision timelines.

That kind of integration cannot happen in isolation.

Conferences and Technical Exchanges as Operational Enablers

Among the most visible contributions made by DEPS are its conferences, symposia, and technical exchanges. Events such as the Directed Energy Systems Symposium, Directed Energy Science and Technology Symposium, and Directed Energy Test and Evaluation Conference have become central venues for collaboration across the directed energy enterprise.

These events do far more than showcase technical papers.

They create environments where researchers, operators, acquisition professionals, program managers, test organizations, and industry leaders can exchange information in ways that directly influence capability transition. In many advanced defense technology areas, one of the greatest obstacles is the disconnect between laboratory innovation and operational employment. DEPS conferences help narrow that gap.

The interdisciplinary nature of directed energy makes these interactions especially valuable. Progress depends on expertise spanning optics, photonics, RF engineering, pulsed power, atmospheric science, software engineering, artificial intelligence, systems integration, operational analysis, lethality assessment, and test and evaluation. Few, if any, organizations possess all that expertise internally.

DEPS conferences create the connective tissue between those disciplines.

The classified and controlled portions of these events are particularly important. Many operationally relevant discussions involving threat intelligence, integration architectures, survivability, testing methodologies, and combat observations require trusted forums where cleared participants can engage candidly.

Beyond the technical value, these events also build enduring professional networks across the community. Those relationships often become critical when organizations must work together quickly to solve operational integration problems or accelerate transition efforts under urgent timelines.

Supporting Operational Integration and Warfighter Understanding

Directed energy systems introduce operational considerations that differ substantially from traditional kinetic weapons. Environmental conditions, platform integration, target characteristics, and battle management architectures can all influence system effectiveness in ways that operators must understand.

That creates a strong need for ongoing collaboration between the technical community and the warfighter.

DEPS helps support this dialogue by creating forums where operators, engineers and scientists, analysts, and acquisition professionals can discuss emerging operational concepts, tactical challenges, and integration requirements.

Directed energy weapons are unlikely to function as standalone systems. They will operate as part of layered architectures that include kinetic interceptors, sensors, electronic warfare systems, command-and-control networks, and increasingly AI-enabled decision-support tools.

Understanding how those systems interact operationally is essential.

Researchers need visibility into real-world operational constraints. Warfighters need realistic expectations regarding capability limitations and performance tradeoffs. Acquisition organizations need insight into how these systems will integrate into future force structures and sustainment models.

DEPS helps bring those perspectives together.

The organization also supports discussions surrounding operational analysis, modeling and simulation, lethality methodologies, and tactical decision-support frameworks. As battle management becomes increasingly dynamic and data-driven, these disciplines will play an expanding role in future directed energy employment.

Operational success will depend not only on the weapon itself, but on how effectively it is integrated into broader combat architectures.

Workforce Development and Professional Education

The long-term success of directed energy capabilities being transitioned to the warfighter depends heavily upon workforce development.

Directed energy technologies require expertise across a wide range of scientific, engineering, operational, and analytical disciplines. At the same time, many of these technical fields face increasing workforce competition and growing demand across both the defense sector and commercial industry.

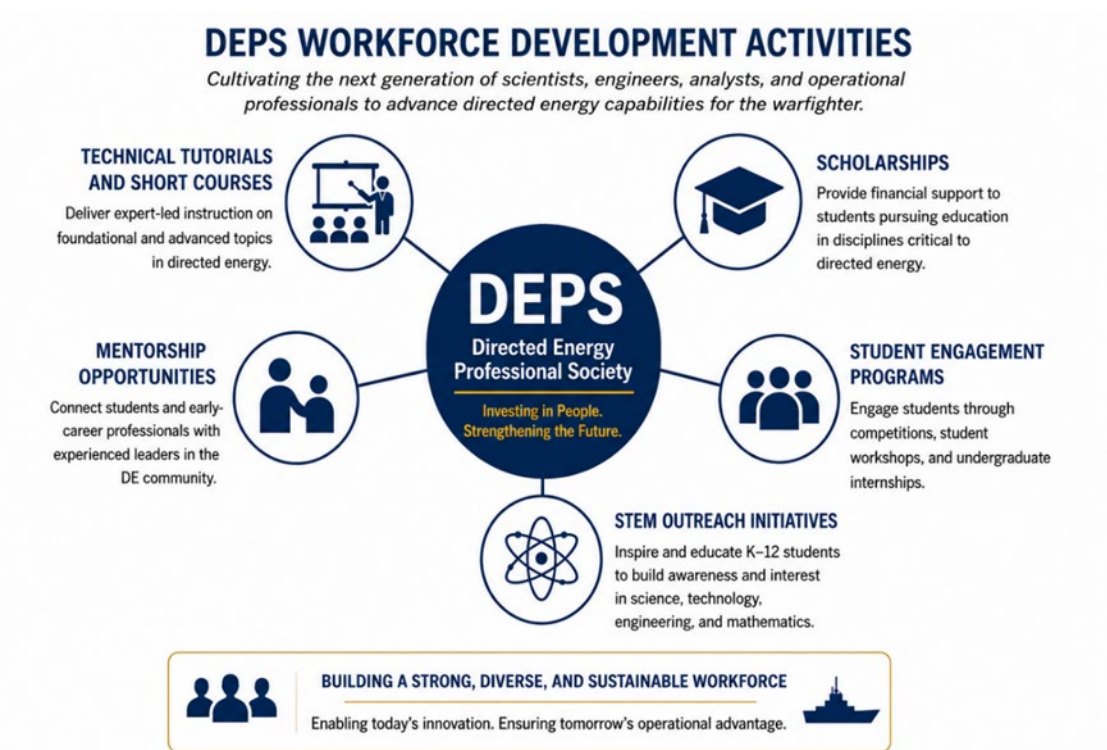


Figure 2 DEPS Workforce Development

DEPS is the leading organization supporting professional education and workforce development within the directed energy community.

The organization's educational activities include technical tutorials, short courses, scholarships, mentorship opportunities, student engagement programs, science fairs, and STEM outreach initiatives. These programs help cultivate the next generation of scientists, engineers, analysts, and operational professionals who will support future directed energy capability development.

For more than 27 years, DEPS has played a vital role in strengthening the nation's directed energy (DE) workforce pipeline through a broad range of professional development and educational initiatives. Among the most impactful of these efforts is the DEPS Graduate Research Grant Program, a highly competitive annual program that supports exceptional graduate students conducting DE-related research at universities across the United States. Through this program, graduate students submit proposal-style applications that not only demonstrate the technical merit of their research, but also showcase their potential to become future leaders within the directed energy community.

Since 2011, with support from the Office of Naval Research (ONR) and the OUSW(R&E)/SCADE Joint Directed Energy Technology Office (JDETO), DEPS has administered 235 graduate research grants totaling more than \$2 million. The program supports graduate students conducting directed energy-related research at universities across the United States. Applications are competitively evaluated by the DEPS Board of Scientific and Engineering Advisors, composed of many of the nation's most respected directed energy scientists and engineers.

The results have been exceptionally strong.

Since 2016, DEPS has administered 173 graduate awards supporting graduate research in directed-energy-related disciplines. Although some recipients remain in graduate school, many have already transitioned into positions supporting Army, Navy, and Air Force laboratories, national laboratories, academia, and defense industry organizations.

Most notably, greater than 90 percent of funded scholars who completed their studies over the last ten years have entered the directed energy workforce.

This exceptional transition rate demonstrates that the DEPS grant program is not simply funding academic research—it is producing highly qualified scientists and engineers who are directly contributing to the development, fielding, and sustainment of critical directed energy capabilities for the warfighter. Building on this proven success, DEPS is actively exploring opportunities to expand the scope and reach of the program in the years ahead, enabling support for a larger number of graduate students and helping to ensure the United States maintains the robust, technically advanced directed energy workforce required to meet future national security challenges.

The value of these initiatives extends beyond technical education. Conferences and professional programs expose students and early-career engineers to the broader operational context surrounding directed energy systems. They gain access to senior leaders, researchers, operators, and industry professionals who often shape long-term career development and collaboration opportunities.

DEPS also plays an important role in continuing education across the existing workforce. Directed energy technologies are evolving rapidly, and maintaining workforce competency requires sustained professional development across a wide range of disciplines.

As global competition for advanced technical talent continues to intensify, organizations capable of supporting workforce continuity and professional integration will remain strategically important.

Strategic Outreach and National Engagement

Technical progress alone is not enough to sustain directed energy development. Long-term success also depends on continued engagement with senior defense leaders, policymakers, acquisition officials, and Congress.

DEPS has become an important part of that broader engagement effort.

The organization helps increase awareness regarding operational applications, workforce needs, integration challenges, and the strategic relevance of directed energy technologies. This is particularly important because directed energy concepts often differ substantially from traditional kinetic defense models.

Senior decision-makers benefit from opportunities to engage directly with researchers, operational users, and technical experts. DEPS helps facilitate those interactions through conferences, educational briefings, outreach events, and technical demonstrations.

One example is the Directed Energy to Washington, D.C. (DE2DC) initiative, which has included Pentagon courtyard demonstrations and congressional outreach events in the Rayburn Building. DEPS also conducts educational briefings for congressional staff to improve understanding of both the capabilities and limitations associated with directed energy systems.

The organization additionally publishes an annual educational outreach booklet highlighting government laboratories, academic institutions, and industry organizations actively engaged in directed energy development.

Congressional engagement remains especially important. Directed energy programs compete for resources within constrained fiscal environments, and long-term continuity is essential if these technologies are to achieve meaningful operational impact. Educational engagement helps policymakers better understand the role directed energy may play in future conflict environments shaped by autonomous systems, contested electromagnetic conditions, and unfavorable kinetic cost-exchange ratios.

These outreach efforts also reinforce a broader point: directed energy development is fundamentally a collaborative enterprise. Progress depends on maintaining alignment across operational users, laboratories, acquisition agencies, industry, and policymakers.

DEPS continues to strengthen that alignment.

Conclusion and Strategic Vision for the Future of DEPS

Directed energy is no longer a distant research concept. High-energy laser and high-power microwave systems are steadily transitioning into operational military capabilities with growing relevance across counter-UAS operations, air and missile defense, electromagnetic warfare, and multi-domain operations.

As these systems mature, the central challenge increasingly shifts from invention to integration.

Successfully fielding directed energy capability requires sustained coordination across researchers, engineers, warfighters, acquisition organizations, analysts, educators, test agencies, industry partners, and policymakers. No single organization can independently solve the technical, operational, and workforce challenges associated with this transition.

That is where DEPS has become uniquely important.

Through conferences, technical exchanges, educational programs, workforce initiatives, and strategic engagement activities, DEPS helps provide the professional infrastructure needed to connect the broader directed energy enterprise. Clearly, the organization does not build weapon systems directly. Its value lies in enabling the collaboration, operational dialogue, and professional integration necessary for the community to succeed.

The next decade will likely determine whether directed energy becomes a fully integrated operational capability or remains a collection of promising but disconnected technologies. That reality also changes the role DEPS itself must play going forward.

Historically, DEPS functioned primarily as a facilitator of technical exchange. Increasingly, however, it must operate as a strategic integrator across the broader directed energy ecosystem. As directed energy becomes more tightly linked with AI-enabled battle management, electronic warfare, autonomy, sensing, and layered defense architectures, institutional alignment across the community becomes just as important as the underlying technology.

This evolution is significant because DEPS itself remains a relatively small nonprofit organization with modest staff and limited institutional resources. Yet much like directed energy has evolved from a niche technical discipline into a foundational component of future warfare, DEPS must continue evolving as well.

Its long-term importance will increasingly be measured not simply by the conferences it hosts, but by how effectively it strengthens the national directed energy enterprise.

In many respects, DEPS now occupies a position similar to what organizations such as AIAA, AFCEA, AOC, and NDIA represented during earlier periods of military-technological transformation. No other organization is better positioned to connect operational users, laboratories, acquisition agencies, industry, academia, and policymakers into a coherent collaborative framework as effectively or credibly as DEPS.

That role should shape the organization's future direction.

In the near term, DEPS will continue emphasizing operational convergence across the directed energy community by strengthening engagement among warfighters, researchers, developers, acquisition organizations, and analysts. Workforce development must remain a major priority as demand for expertise

in optics, RF systems, power management, AI integration, software engineering, and operational analysis continues to grow faster than supply.

In the mid-term, DEPS should further establish itself as the principal joint and allied collaboration environment for operationally relevant directed energy integration. As systems move toward broader deployment, challenges involving doctrine, sustainment, interoperability, tactics development, and joint battle management integration will become increasingly important.

Over the longer term, DEPS should aspire to become the enduring strategic institution supporting directed energy as an operational warfare domain. Future combat operations will likely integrate kinetic and non-kinetic effects across the electromagnetic spectrum, cyber domain, space domain, and physical battlespace simultaneously. Directed energy systems will increasingly merge with sensing, autonomy, AI, communications, and electronic warfare into highly networked operational architectures.

DEPS can help provide the intellectual and collaborative foundation for that future.

Achieving this vision will require deliberate long-term focus. Operational integration with the warfighter community must deepen. Workforce initiatives—including scholarships, internships, mentorship programs, university partnerships, and student competitions—must expand. Trusted classified collaboration environments will become even more important as operational deployment accelerates. Strategic outreach with Congress and senior defense leadership must continue strengthening to sustain long-term momentum.

Perhaps most importantly, DEPS can help shape the broader intellectual framework surrounding directed energy warfare itself. The organizational membership possesses the technical depth and professional credibility needed to convene discussions involving doctrine, deterrence, AI integration, electromagnetic maneuver warfare, escalation management, and future multi-domain operational concepts.

The strategic importance of this mission should not be underestimated.

Nations capable of operationalizing scalable, affordable, and sustainable directed energy systems will possess significant advantages in future conflicts shaped by autonomous systems, contested electromagnetic environments, compressed decision timelines, and increasingly unfavorable kinetic cost-exchange ratios.

But technological superiority alone will not determine success.

Success will depend on how effectively nations integrate technology development, operations, acquisition strategy, workforce development, and professional collaboration into a unified enterprise capable of adapting faster than potential adversaries.

Organizations like DEPS are becoming indispensable to that effort.

DEPS is no longer simply supporting a technical community. It is helping build the professional, operational, and intellectual foundation upon which the future of directed energy warfare may ultimately depend.