Norwich University Applied Research Institutes

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Final Technical Report

Introduction

The Norwich University Applied Research Institutes (NUARI) led the effort to develop an Energy Track within the Norwich University (NU) Center for Global Resilience & Security (CGRS) by submitting a proposal to plan the CGRS Energy Track in FY18. The Norwich University Center for Global Resilience and Security was established in March 2017 with the goal of bringing together NU's unique strength in leadership, security, experiential education, and perseverance to resilient community building. NUARI's FY18 proposal was to develop the plan for the CGRS Energy Track—a program focused on building the educational foundation for energy resilience at military installations and more broadly in the municipal, state, national and global ecosystems they exist within. This phase (Phase I "PLAN") of the Energy Track included planning a literature review, stakeholder engagement, Round Table events, and workgroups to gather, analyze and disseminate information regarding energy security initiatives, best practices, and standards.

The CGRS Energy Track was seen as a foundational step to use the energy resilience education model to eventually address the operational and economic realities of water, waste, and agriculture in subsequent phases of this program development. Building upon this research and engaging senior officials and subject matter experts, CGRS was to develop a roadmap for energy resilience education, which will inform the next phase ("DESIGN") of the program to develop curricula, establish educational learning partnerships and design programs for the final phase (Phase III "IMPLEMENTATION").

The outcomes of the PLAN phase underscored the need for a university-wide Energy Track leveraging the capabilities of NU across the undergraduate, graduate, on-campus, and online levels and the importance of furthering the partnership with PLAN phase SMEs and networks to create strong educational partnerships for experiential and research activities. Therefore, in the DESIGN phase of the Norwich University and CGRS Energy Track, the team, led by NUARI, will use the university's multi-level capabilities and its centers of excellence, to guide, enhance and sustain the development of new initiatives that will lay the educational foundation for operational and installation energy resilience for the Department of Defense (DoD).

The DESIGN phase of this project is intended to develop a Norwich University and CGRS Energy Track that is sustainable and meets Army operational and research requirements for enactment in Phase III IMPLEMENTATION. The desired outcomes of Phase II DESIGN include:

1. Development of Energy Track coursework (short lectures, simulations, role-playing, war-gaming, problem-based learning and project development at the undergraduate, graduate, mid-officer and senior leader levels;
2. Creation of experiential learning and research partnerships for hands-on training;
3. Senior leader engagement;

4. Initial concept and design of knowledge repository and dissemination platform for operational and installation energy resilience, including publication of important findings; and
5. Formation of selected pilot activities, serving as the foundation for Phase III – IMPLEMENTATION, which will offer students and military professionals a variety of opportunities to gain mission-critical competencies related to energy resilience.

Summary of Contract Activities

The effort to develop the Norwich University Energy Track was a highly collaborative and innovative exercise that engaged over 100 subject matter experts across disciplines, job functions and organizations from all military services, industry and academia. The impetus for the development of the Energy Track is the critical and growing national security need for installation and operational energy resilience. Lessons learned from recent international conflicts, as well as the vulnerability of military installations due to increased global interconnectedness and complexity inspired senior military and civilian leaders to invest in education and training that would build the capacity of the military to implement resilient energy systems.

The three round table discussions that formed the foundation of the contract activities were designed to convene subject matter experts with the purpose of translating those lessons learned and their experience into an education and training platform to support the military's energy resilience goals and mission effectiveness. The following sub-sections detail each of the round table discussions on 1) Energy Fundamentals, 2) Public-Private Partnerships and 3) Funding Mechanisms and Cyber.

Round Table 1: Energy Fundamentals

On April 3-4, 2019, stakeholders and subject matter experts convened to contribute their perspectives to the establishment of the Energy Resilience Track at CGRS. The focus of the discussion was on Energy Fundamentals.

Each discussion on the fuel, generation, transfer, and storage raised a large list of topics that would benefit an energy curriculum. Some of these topics are covered within specific classes, even though the focus is purely on the concept, and its limited technical application. Using the experts from the round table and their networks, instructors involved in the CGRS Energy Track will be able to develop specific examples, and case studies, including successes (for example where certain fuels were swapped from traditional to renewable sources), and lessons learned for deeper student engagement and understanding.

As cyber, physical and acts-of-nature threats of are not traditionally covered in engineering courses covering energy resilience, they are key in the military installation and operational side (as repeatedly discussed during Round Table 1) and it is imperative that CGRS expand outreach efforts to colleagues who cover these topics to include relevant material in the Energy Track curriculum, even if they do not typically cover these in the context of energy resilience.

One immediate follow up on recommendations for the energy resilience tracks came from David Heap, a participant in Round Table 1 (RT1). David previewed the Norwich University course catalogue and presented a vision with specific courses attached to two tracks as shown below in Tables 1 and 2.

Energy Resilience - Technology Track			
	Credits	Code	Title
Eng	3	EG 203	Materials Science
Civil	4	CE 220	Introduction to Environmental Technology
	4	CE 421	Environmental Engineering
	3	CE 460	Construction Management
Elec	3	EE 315	Electrical Energy Systems
	3	EE 459	Electric Power Systems
Mech	3	ME 370	Mechanical Systems Design
PM	3	EM 461	Project Management
Env Sci	4	ES 270	Fundamentals of Environmental Science
Cap	3	---	Energy Resilience

Total Hours: 33

Table 1. Energy Resilience – Technology Track

Energy Resilience - Management Track			
	Credits	Code	Title
Eng	3	EG 400	Design Thinking and Innovation
Acct	3	AC 201	Introduction to Accounting and Financial World
Comp Sci	3	CS 300	Management Information Systems
Comp Sci	3	CS 407	Politics of Cyberspace
Eng	3	EG 350	Engineering Economics and Decision Analysis
Mgmt	3	MG 309	Management of Organizations
	3	MG 351	Organizational Behavior
Poly Sci	3	PO 106	Introduction to Public Policy and Administration
Psych	3	PY 232	Engineering Psychology
Socio	3	SO 330	Military Sociology
Cap	3	---	Energy Resilience

Total Hours 33

Table 2. Energy Resilience – Management Track

The conversations resulting from RT1 have also deepened CGRS discussions with local and regional partners including Vermont's Energy Action Network, and various utilities and energy related non-profits that regularly partner with Norwich University.

The interviews from April 4 provide the following opportunities for the CGRS Energy Track:

- Access to experts with different perspectives on the questions that were raised during the interviews.
- Opportunities to engage faculty and students who are not directly researching energy resilience (for example faculty members working on Smart transportation may be interested in connecting their work with the role that energy plays in smart transportation, and the consequences of the inter-connections in these areas for military installation and operation).
- Leads on tools, agencies, policies, strategies, manuals of practice, industry standards, etc. that should be considered in curriculum development.
- Designing a follow up survey to expand on the one that was administered prior to RT 1.
- Events, conferences, workshops, that faculty involved in the CGRS Energy Track development efforts should go to/be aware of, as well as people who could be mentors, advisers, guest and adjunct lecturers.

Both the round table discussions and the interviews provided a range of options to take the CGRS curriculum development in, from leads on whom to engage on RT2 on public-private partnerships, to how to implement the curriculum, once the planning phase is complete. Some of these leads include running table top exercises, using online platforms for scenario planning, etc.

Round Table 2: Public Private Partnerships

On June 18-19, 2019, stakeholders and subject matter experts convened to contribute their perspectives to the establishment of the Energy Resilience Track at CGRS. The focus of the discussion was on Public Private Partnerships (P3). The questions posed during RT2 across the two days include the following: How can organizations better leverage P3 to enable rapid innovation? What are the most important things CGRS students have to know about the P3 approach?

The discussion revealed that the process for rapid innovation is not uniform across DoD entities, let alone in various other private organizations and non-DoD public sector groups. Therefore, some key tenets of the P3 process should be a part of the Energy Track curriculum to include the following possibilities as examples of a more comprehensive list that will be developed over time:

- A comprehensive knowledge of the organizational structure and chain of command.
- A working knowledge of contracts and negotiations.

- An awareness of forums such as industry days to generate ideas.
- Possible funding mechanisms that will play a key role in P3.

There was an acknowledgement that this aspect of curriculum development is necessary as both industry and DoD sides need in-house expertise on P3, including a common understanding of terms associated with P3.

Barriers to transparency, especially related to legalities, were considered to be true challenges. Education and participation in conversations during events like Industry days and having NU/CGRS host Technical Industry Liaison Officer (TILO) for sharing advanced technological advancements were considered to be a way to start addressing these concerns.

The participants identified the most important topic areas about P3 as it relates to the military:

- Energy savings performance contracts
- Policy and regulation: The discussion focused on the DoD requirements language
- Lean manufacturing

During RT2 the use of sli.do and small group conversations added to the conversation on P3 with the following key takeaways:

1. The P3 elements discussed throughout RT2 may be relevant as a stand-alone piece of the curriculum at the more senior entry points, such as managers and senior leaders, who already have an understanding of the P3 process. At the lower entry levels, especially in the undergraduate curriculum, it may be more relevant to embed P3 concepts in multiple course offerings throughout the four years, so that students can appreciate topics such as risk, organizational structure, process flows, etc. in context. Using examples or case studies related to energy resilience may be the best way to show students the P3 path within the energy resilience sector.
2. All students should have a clear understanding of various terms associated with P3, and the roles of the “public” and “private” as they apply to DoD specifically, because these may be different as compared to P3 contracts pursued in the non-DoD public sector, for example in local municipalities.
3. Risk assessment, analysis, communication as it related to energy resilience related policy and regulations (including the development of DoD requirements and RFPs), technology development, finance instruments, etc. were unanimously considered relevant to the P3 component of a CGRS curriculum on energy resilience.
4. A comprehensive database of both successes and failures on P3 in the DoD would be helpful to everyone from senior leaders to undergraduates involved in the CGRS energy resilience track. This is critical to a deep understanding of energy resilience and P3.

5. A modular structure for the P3 related CGRS Energy Track curriculum could feature the following units - to be embedded at different levels depending on entry points into the curriculum (undergraduates to senior military leaders):
    - Legalities and contracts
    - Case studies
    - Leadership
    - Target audience
    - Portfolios

Round Table 3: Funding Mechanisms, Day 1

On September 23-24, 2019, stakeholders and subject matter experts convened to contribute their perspectives to the establishment of the Energy Resilience Track at CGRS. The focus of the discussion was Funding Mechanisms on Day 1 and Cybersecurity on Day 2.
The objectives laid out for RT3 were:

- To identify and assess funding mechanisms and financing that can support operational and installation energy resilience as well as how the incorporation of the resulting outputs from the facilitated discussion into curriculum and training programs while also considering the unique mission requirements, reliability, security, adaptability and risk thresholds.
- To determine the impact of policies and directives in prioritizing and performing resilience actions so as to be fiscally responsible, while protecting the homeland.
- To explore the cyber-physical threats and vulnerabilities that challenge operational and installation energy resilience.

RT3 addressed many of the same subject areas covered in RT2, Public Private Partnerships, such as policy concerns, management, leadership challenges, risk assessment and others. However, the focus on funding allowed for the participants to present a comprehensive overview of relevant funding opportunities and programs that could support operational and installation energy resilience and additionally allowed for a presentation and discussion of funding via Public-Public partnerships, which was not covered in previous round tables.

Further, RT3 used case studies to engage participants in the discussions on funding mechanisms and cyber security considerations in energy resilience in both an installation and operational setting. The case studies based on real-life experiences were an engaging way to move the conversation forward and provided many specifics that can be embedded into the multi-tier curricula in various helpful ways. Specifically, the case studies allowed for discussions on decision-making hierarchies on base and in the field, risks associated with lack of education (for example falling prey to phishing attacks in Colorado as explained by Lt. Col Bragg), benefits of a strong public-public partnership (Fred Meurer's presentation), liability around the duration of contracts such as the Energy Performance Savings Contracts (ESPCs) in volatile markets (Fort Drum presentation by Hon. Katherine Hammack), and other topics.

The case studies underscored the need for interdisciplinarity in the Energy Track curriculum and for students of all majors to be trained in energy resilience issues, even if we start from their disciplinary lenses. The case studies also revealed how one challenge faced by the right energy manager, or garrison commander, could become a catalyst for multiple forms of energy resilience (and by extension, water, food, and other forms of overall resilience) and help create processes for managing previously unknown challenges. Not only can case studies be used to identify gaps in technology, policy, funding and mindsets, case studies also provide an effective tool to catalyze discussion and evaluation of energy resilience programs by senior leadership. Also, case studies can be used as a pedagogical tool for all of the target populations identified in the Energy Track Road Map: Entry Level, Mid-Career and Senior Leaders.

With case studies focusing on past issues, tabletop exercises, simulations, reverse-pitches and other similar activities can be used to inform decision making, training and learning regarding current and future issues in operational and installation energy resilience.

The presentations from subject matter experts and senior leaders in RT3 highlighted the need to capture the deep and broad institutional knowledge held by particular individuals and integrate that knowledge into the Energy Track curriculum. Regular interviews, as used in RT1, may provide a data collection technique as well as videos, lecture series and other methods that can be considered as the Energy Track is developed. The following sections, *Discussions* and *Presentations*, summarize the data collected in RT3.

Discussions

Hon. Katherine Hammack shared multiple funding mechanisms that DoD can/have/are using to address energy resilience including Privatization of Army Lodging, Utilities Privatization, ESPCs, ESTCP, SERDP, etc. Her message that P3s in the Army helped create faster fixes, of better quality, with low risk, and increased renewable energy and clean water resonated throughout the discussions. Very specific questions were raised on the value and ability to measure resilience in the context of risk and liability.

The discussions on the innovative funding mechanisms and the creative solutions that were being implemented as seen in the various case studies led to an important question, “Who came up with these innovations?” “Were these a one-time solution or sustainable over a longer duration?” The sustainability was especially considered critical as leadership undergoes changes and brings with it the risk of losing institutional or personal knowledge behind an innovative mechanism, process, or solution.

Fred Meurer's presentation led to a long and engaging discussion on some of the factors that allowed for the success of the Presidio of Monterey. This discussion centered around: location proximity; leadership capabilities and vision; communities interested in embedding the installation energy resilience as part of their community economic development model; the role of Smart Cities in looking at the regional maps and collaborating with defense bases; possibility of energy managers getting trained in municipalities that are making strong energy resilience changes based on sound strategic planning; the role of the National Guard; the differences in

training across different installations; how these differences impact mission readiness; and partnerships that have not even been identified or developed as yet, because of the changing nature of this field.

In the case study on the Detroit Arsenal presented by Ms. Shannon Bergt, some key discussion items led to insights on how losing a substation during ice storms (or otherwise) does not just challenge energy resilience from an energy availability, access, and use perspective, but also impedes DoD's ability to be mission ready. It also highlighted the fact that as infrastructure across our military bases is aging, a robust R&D program that can strengthen what feeds into base and energy master plans, and trains the managers on technical aspects, creates the processes to help senior leaders make the right decision to "do it right the first time" as infrastructure improvements become necessary. In this context, there was an acknowledgement that we do not have personnel trained and ready to run a microgrid. Collaborating with military labs and universities, partnering with the local utilities and national guard units were all discussed as ways to build resilient systems.

The briefing provided by Dominic Frinzi on Schofield Barracks and the use of Direct Private Investments as a way to leverage land to promote and pay for energy resilience closed out the discussions on RT3 Day 1. This was an abbreviated discussion due to lack of time, making it clear that this is a true gap in our existing frameworks - the ability for experts across sectors to sit at a table and share their expertise in a way that can help a common neutral entity (in this case NU) listen to all sides, and help build a roadmap to a curriculum that is necessary for all.

Presentations

Each day of RT3 provided an overview of Norwich University, NUARI, and CGRS, the Energy Track and the accomplishments of RT1 and RT2. Unexpectedly, this introductory presentation resulted in robust conversations, and excellent questions including whether or not the team had looked at Department of Energy policies and how their policies intersect with the military.

Another big question noted previously was "Who else is doing this?" There was also a strong consensus on the value of these round tables, as a way for multiple cross-sectoral SMEs to "deposit their knowledge." It was noted that the opportunity to create a framework so it thrives - in a neutral environment - outside of priorities of the moment (because DoD resources are often focused on matters of current and therefore changing imperatives), is critical and that NU can be the entity to play this important role of the neutral third party. Offering a space and platform for information exchange, and providing the pathway for research and development in collaboration with our military labs, were briefly discussed in the NU context.

Using the example of an Executive Order that was just issued, questions such as "Who are the people responsible for protecting industrial control systems (ICS)?" "What are they being trained in?" were raised, even as it was acknowledged that ICS covers lighting control, fire suppression, alarms, PLC, controls, chips, etc., and without the right educational background or awareness training, being responsible for these is an uphill battle for energy managers. Some changes that

were recommended were brief guides with persuasive reasons to help leaders with mindsets of "we have always done it this way" embrace the innovations.

There was a general acknowledgement that to maintain a sustained workforce, DoD will have to work harder at protecting its assets (its people), as brain drain is a real risk. Some of the options to extend knowledge base were discussed.

Round Table 3: Cyber, Day 2

While Day 1 of RT3 on energy funding mechanisms featured multiple case studies, Day 2 on cybersecurity considerations included presentations that embedded case studies within the presentation as a way to share examples. The gaps identified in the cyber-presentations offer research topics, internship opportunities, mid-career training opportunities and seminar themes that can be incorporated into the Energy Track. The presentation by Col. Scott Nelson provided an overview of the cyber-energy nexus from the Cyber Command perspective. His reminders summarized in the bullets in his presentation resulted in conversations on:

- How networking everything for convenience poses a big vulnerability and the role played in Nation state/Advanced Performance Threats (APTs).
- The need for a diverse, interdisciplinary talent/workforce that recognizes risk, design, business, biology, political science, etc.
- Industrial Control System (ICS)/SCADA and Internet of Things (IoT).
- Supply chain related threats as private infrastructure and P3 increase.
- Information sharing.
- Whole of nation problem - the need to share information across the board. For example, vulnerabilities in and threats faced by companies like Google is a threat to the government, and vice versa.

The imperatives shared by Col Nelson emphasized that building the right defense capacity and capability is hard, but will be easier to sustain once it is built right. He noted that preventing the theft of intellectual property and research from universities will be critical in maintaining US technological advantage. Finally, he also recommended that information sharing through networks (sensors and people) in trustworthy ways so that the flow is bi-direction from installation to Cyber Command and back to the communities will be important. His analogy of how CDC handles pandemics was well received.

The presentation by LTC Rhodes modeled the use of compelling content in a persuasive information brief style pedagogy just as well as it demonstrated the need to secure our energy systems against cyber crime and warfare. LTC Rhodes also noted that smart cities are extremely vulnerable, that as big cities are developing strong cyber defenses, bad actors had moved on to smaller cities and municipalities, and are exploring vulnerabilities brought about by commonality of systems, through similar processes, common vendors, etc. An important discussion that emerged in this presentation was with the problem with cyber security niches; i.e. when some people are technical experts, others are policy experts, etc. and not everyone may have an idea

of the other pieces enough to connect the dots. The lack of a degree or continuing education program that can help DoD employees develop cross-connected expertise was noted (most are accidental experts - not intentional). LTC Rhodes recommended that every state and territory should have a defensive cyber operations tactical unit.

The closing presentation by NUARI President, Phil Susmann not only helped bring the day's conversations to a close, but also helped connect with the big picture behind this work. By sharing all the ways that NU, through NUARI, had helped institutions become cyber secure and more resilient in the financial and energy sectors, Phil's presentation underscored NU's commitment to build the Energy Track curriculum using a hands-on experiential model that would emphasize interdisciplinarity and offer pathways at multiple levels for a sound educational experience.

Overall, the need for a deeper conversation on cyber concerns and how cyber intersects with energy resilience was heard on Day 1 and by adapting the RT3 programming to include a day on Cyber we were able to include that discussion, which highlighted additional gaps that NU curriculum will be able to close in future years. There was a charge on how a strong curricular framework can help create intentional cross-sectoral experts - i.e. create a specialization that people may self-tag, but do it in a way that does not impede their promotion.

NU Stakeholder Round Tables and Other Outreach

The purpose of the NU Stakeholder Round Tables was to present the CGRS Energy Track to interested faculty and other NU stakeholders with the goal of successfully implementing the Energy Track's comprehensive roadmap at NU and beyond. The NU Round Table provided a forum for communication between NU stakeholders, policy makers and subject matter experts regarding the progress of the Energy Track and focused on implementation and sustainability. These activities were not specified in the contract, but were instrumental in the development of the Road Map and the Research Agenda. NU RT1 was held on May 9, 2019 and NU RT2 was held on November 8, 2019.

For the first of these internal round table discussions, there were ten faculty participants, primarily from the engineering department and after a brief introduction, CGRS presented an overview of RT1: Energy Fundamentals and Threat Vectors: April 3-4, 2019, Washington, DC and then participated in an interactive exercise where faculty identified where they would like to enhance their curriculum to include topics discussed by the subject matter experts at RT1. The NU round table concluded with a discussion of priorities and next steps regarding the planning of the Energy Track.

The second of the internal round table discussions was held on November 8, 2019 and its purpose was to share the highlights of the discussions and takeaways from RT2 and RT3 held in June and September 2019 in Washington DC with the Norwich Academic teams (on-campus undergraduate, online undergraduate, graduate, Norwich Pro, and NUARI) and other NU stakeholders. The draft Road Map was presented to interested faculty across the various NU education delivery platforms and the next steps were discussed.

Implementation Road Map

The Energy Track must be built on the foundation of assessing three key items:

- What roles in DoD demand what levels of proficiency in energy resilience?
- What is the educational background and energy resilience literacy of those currently employed in these positions?
- What kinds of energy resilience education gaps exist in current curricula that prevent those employed in these roles to perform their functions effectively?

These questions underscore the success of the PLAN phase of this project, where our goal was to develop a roadmap for energy resilience curriculum, because they set a path for the next DESIGN phase of this work, where we will be able to answer these questions and create the curricular options.

The synergies of this NUARI-led consortium of the CGRS, CGCS, and Norwich Pro platforms; the broad range of subject matter experts who participated in RT1, RT2, and RT3; and those that could not participate, but are part of the 200-year-old Norwich University network, are ideally placed to research the questions posed above to be able to work on the next DESIGN phase of this work.

Figure 1 represents an overview of the Road Map for the Energy Track, which outlines the research agenda in terms of a) course development for three groups differentiated by experience levels: entry-level, mid-career, senior leaders; and b) interdisciplinary research in areas that are germane to operational and installation energy resilience and security, including policy, cyber-energy solutions and resilient cities. The outputs of the Energy Track will take the form of curriculum, publications (including white papers and peer reviewed articles), and innovations at the intersection of technology, policy and partnerships. The Energy Track will be accessible to the broad community of stakeholders that are central to military mission, including military personnel as well as industry, the civilian public sector, and academia.

Figure 1. NU Energy Resilience Project Mission: Drive Generational Change in the Army for Energy (Operations and Installation)

Entry Level

At the entry-level, the Energy Track would seek to enhance awareness of issues in energy resilience across all disciplines starting with course modules, new classes and selected concentration and certificate programs. Norwich University will create an Energy Track in the Engineering department and will expose students in other disciplines to the energy resilience curriculum. The primary focus would be on the fundamentals including:

a) Electrical power: sources, distribution and loads
b) Controls
c) Communication
d) Cybersecurity

In taking stock of the current course offerings at Norwich, many of the energy resilience fundamentals are currently offered. In Phase 2 of the Energy Track, NU will work to combine classes into curricula that include the key competencies identified by the SME's, and will also develop courses that have been identified as gaps in the current curriculum. See Appendix 2 for a collaborative exercise conducted amongst NU faculty to identify the courses where energy resilience topics could be incorporated.

Mid-Career

For Mid-Career professionals, the Energy Track will provide tactical to operational knowledge to Mid-career, military and DoD civilian professionals who have the positional authority to

positively influence the energy resilience in a military organization. The purpose of this effort is to communicate the knowledge required to effectively evaluate the Entry-Level energy risk assessments for integration at the middle management level risk assessment process and subsequently integrated into the Energy Master Plan.

Installation – Garrison Commander and Deputy to the Garrison Commander, Director of Public Works (to include the master planners, energy managers, work order team), Director of Training and Mobilization, Contracting, Director of Logistics, Director of Information Management

Operational – this environment includes the assets to support pre-deployment, deployment, employment, and redeployment of any Operations unit. Training opportunities include the unit to be deployed and the elements supporting pre-deployment and deployment assets such as housing, supply chain, transportation, security, power generation, range operations and cyber/information operations tasks. The deployment tasks include the transportation assets, departure and arrival ports, and the security to get the units to the operational area. The employment focus is on the security, supply chain, cyber, and operational units that requires resilience capabilities such as military police, generator mechanics, the staff operations team, as well as the command structure.

Scientific literacy – consider the requirements and design of a foundational "energy" course that non-scientists could use to support their particular function. See Appendix 2 for detailed presentation of possible areas for implementation of the Energy Track.

Senior Leaders

For Senior Leaders, the Energy Track will provide strategic energy guidance, coordinate strategic energy resourcing, and conduct strategic energy risk assessments and appropriate mitigation, in coordination with a dynamic strategic Energy Master Plan.

A key takeaway from the Energy Track Round Table discussions among senior leaders and industry executives was that having people together, face-to-face, engaged in facilitated and energy-resilience focused sessions will be an invaluable feature of the Energy Track. Sessions can be brief and can leverage regular conferences or meetings where a critical number of stakeholders have convened. The main benefits of these meetings are information sharing, networking and establishing collaborative consortia. Using NU's online and residential platforms, the Energy Track can conduct a pilot residence or hybrid residence-online session for senior leaders in both the installation and operational categories.

Research

Though research focusing on energy resilience is a relatively new area, the growing awareness of industry and academia is reflected in the increasing body of research into topics such as energy resilience engineering, smart cities, resilient design, energy security, effective energy policy and many others. The Energy Track will start by producing white papers and peer-reviewed

publications that share and assess the practical application of the coursework and training that has been developed as part of the program.

Impact on the Army

The Energy Track's impact on the Army will cut across disciplines, job functions and applications:

- Human-centered approach supports mission and innovation
- Continental: resources, competition and threats
- Climate impacts and resource scarcity
- Peer-Peer competition
- Threat postures
- Diversified energy sources
- Rapidly changing operational energy environment
- Cyber and cyber-physical
- Homeland defense

Human-centered approach supports mission and innovation

The DoD has long recognized the role of technological innovations in energy resilience efforts to support both its missions and its human capital. However, what makes the NU plan especially relevant is that even though there is a recognition that to succeed at modernization, the Army has to account for five major aspects - money, planning, teamwork, focus and flexibility – (https://www.forbes.com/sites/lorenthompson/2020/01/17/five-reasons-the-army-may-have-finally-found-a-formula-for-modernization-that-works/#9bc925f54b65) there is no mention of right education and training in this list. This is in contrast to groups who have analyzed (https://www.rand.org/pubs/research_reports/RR1847.html) the human capital needs for DoD, and underscored the education and training gaps in the DoD. The NU energy track plan scaffolds the education and training related to energy resilience technology and missions by accounting for the factors that will allow the Army to modernize. The NU energy track also places the human capital at its core, ensuring that the education and training spans all levels – from entry level to senior leadership.

Continental

A DoD well trained in operational and installation energy resilience considerations at all levels from entry level to senior leaders will be more adept at recognizing the limitations of resources, reusing or repurposing resources, and using innovative solutions to stretch limited energy resources. Further, as competition increases for the same limited energy resources, investment in affordable and easy to use and install renewable energy systems, and storage platforms will allow DoD to prepare for threat vectors, both within the continental US and abroad. Many of the nearly 1,390 military renewable energy projects between 2011 and 2015 were at US bases, to ensure that the base is disconnected from the more vulnerable public electric grid, and therefore more independent during natural disasters or physical/cyber-attacks.

Climate impacts and resource scarcity

The January 2019 "Report on Effects of a changing climate to the Department of Defense" (https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF) looked at the impact of 5 climate related events including recurrent flooding, droughts, desertification, wildfires, and thawing permafrost in 79 mission assurance priority installations in the US over the next 20 years, and noted that recurrent flooding (two thirds of the 79 installations are vulnerable), droughts (more than half of the 79 installations), and wildfires (half of the 79 installations are vulnerable) are the main causes for concern at the 79 installations. Being aware of the climate challenges allow for resilient interventions. Each of the flooding, drought, and wildfire threats can be linked with energy resilience. For example, the impacts of droughts on military readiness include implications to base infrastructure due to deep or wide cracks, ruptured utility lines and cracked road surfaces due to low moisture conditions. These implications included impaired testing, prohibitions on testing and training, etc. In addition, preventing heat related illnesses, (heat exhaustion and stroke) necessitate increased energy consumption to ensure adequate cooling of facilities.

Peer-Peer competition

Competing with military peers seeking leadership in the global energy sector (for example China's investment in renewable energy deployment for ecological and geopolitical reasons (https://www.csis.org/east-green-chinas-global-leadership-renewable-energy) can only be balanced by DoD's strong stand on energy resilience within its operations.

Threat postures

The US DoD stands ready to combat threats from a range of threats – increasingly virtual North Korean and Russian attempts at attacking the electrical grid (https://www.powermag.com/dhs-fbi-identify-tactics-in-cyberattack-campaign-targeting-industrial-control-systems/). Energy systems are no exception and the NU energy track plan includes cyber education to address the current threats.

Diversified energy sources

Solar power is replacing some diesel fuel usage, minimizing the vulnerability to traditional fuel carrying convoys and allowing for silent operations, especially while traversing through enemy terrains. Gas Electric hybrid battleships make an economic case (less fuel and stops) as well as a strategic one by minimizing the chances of attacks like the bombing of USS Cole in 2000 during a refueling stop in Yemen.

Rapidly changing operational energy environment

Fuel transport is one of the riskiest energy operations in DoD. It was reported that one in nearly 40 fuel convoys in Iraq in 2007 resulted in a death or serious injury (https://www.reuters.com/article/us-usa-military-green-energy-insight/us-military-marches-forward-on-green-energy-despite-trump-idUSKBN1683BL).

Solar panels, such as the ones carried to forward bases by marines in Afghanistan in 2009 in battles with the Taliban, power communication devices including GPS and night vision goggles allowing for silent operations and reducing vulnerability to attacks on convoys.

Cyber and cyber-physical
From blackouts that caused a loss of power to 50 million people in 2003 in Northeastern US and Canada, to the 225,000 Ukrainians who experienced the same when their grid went down twice within a span of a little over a year the role of cyber vulnerabilities in critical energy infrastructure or the disruption of physical infrastructure with cyber warfare are likely to increase. The NU Energy track plan will use the relevant discussions in the round tables and interviews with SMEs to address these elements in our energy track plan.

Homeland defense
Asset management planning of critical energy infrastructure (grid, substations, etc.) is an imperative. A sound understanding of the interconnectedness of critical energy infrastructure systems that connect municipal and military installations throughout the homeland will be critical in defending it.

Discussion

The round table discussions provided an engaging and dynamic forum for subject matter experts to identify and assess the fundamental components required to develop the Energy Track. Since energy resilience draws from a diverse areas of expertise, a general consensus on definitions, and inter-changeability of terms used in installation and operational energy resilience, is a key first step in designing or enhancing relevant curriculum. Further, curriculum for the different entry points identified in the Road Map will still require the coverage of a certain number of fundamentals, followed by specialized materials that may be level-specific.

Also, with increasingly globalized networks and supply chains, energy resilience coursework should include at minimum an introduction to how other nations, including China and Russia, manage their energy resources and are developing their own energy resilience, and the impacts of their strategies, policies, and technologies on the US installation and operational energy resilience.

In each of the round table discussions, participants asked "Who else is doing this?" meaning the holistic development of a curriculum around energy resilience that can address topics ranging from energy fundamentals and the technical know-how of renewable technology and microgrid operation, to all the critical non-technical aspects of operational and installation energy resilience such as leadership, mindsets among various levels of leadership, timelines, collaboration, partnerships (public-private, and public-public), role of industry versus government, funding, risk, vulnerability, and threat assessment, physical and cyber security, etc. It was clear, as determined by the round table participants, that the NU curriculum emerging from the work in this contract and the final roadmap that will help us develop the curriculum in the future, will be unique. The contract activities validated the need and sequence of the round tables as developed and conducted, with each conversation emphasizing both the demand for a strong energy resilience

curriculum, as well as setting out path markers on how to develop a robust multi-tiered approach to education and training in this critical area.

Conclusion

As the recent AUSA Spotlight report noted, energy resilience is now recognized as critical to military mission effectiveness. "The U.S. Army—and DoD—must increase focus on energy resilience to remain operationally relevant in the emerging threat environment. Without this foundational critical enabler, it risks the accomplishment of its mission, both domestically and overseas" (p. 7)[1]. Given the emerging importance of energy resilience, there is a need for a university (in this case NU) to serve as the neutral party in developing and disseminating energy resilience related education and training, and by being a space to bring together government and industry to foster conversations that allow for creating a feedback loop on the work that is underway and the curriculum that will be produced in future phases of this project. Several discussions transcended the energy curriculum conversation and involved creating organizational systems and training platforms that will be a model for interdisciplinary collaboration within NU and across multiple external institutions.

[1] "Energy Resilience: An Imperative for a More Lethal, Agile and Strategically-Relevant Force." Col. Daniel Roper, August 2018. https://www.ausa.org/sites/default/files/publications/SL-18-3-Energy-Resilience-An-Imperative-for-a-More-Lethal-Agile-and-Strategically-Relevant-Force.pdf

Norwich University Applied Research Institutes

CONTRACT TITLE: DEVELOPMENT OF AN ENERGY TRACK WITHIN THE NORWICH UNIVERSITY CENTER FOR GLOBAL RESILIENCE AND SECURITY

Round Table #1 Fundamental Energy Agreements: Out Report

Contract No. W913E519C0002

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Executive Summary: Round Table (RT) #1 was conducted on 3-4 April 2019 in Washington DC. The intent of the RT was to engage stakeholders and SMEs around the fundamentals of energy and key knowledge, skills and attributes that should be integrated into the NU Energy track. RT #1 validated the basic framework of NU strategy energy track and the proposed approach for support to the Army. Specific feedback from RT#1 is below. NUARI and NU CGRS continue to discover critical input from stakeholders and subject matter experts.

Next Steps: Engage stakeholders, public and private organizations in RT#2 in a discussion of Public-Private partnerships around energy no later than mid-June 2019.

Round Table #1: Fundamentals of Energy

Prior to the first Round Table, NUARI and team asked for feedback on metrics of success in order to achieve the most effective outcome for all participants. To adequately capture discussion and feedback, we have employed the use of #hashtags. The reader will see these used topically below (e.g. #fundamentals) and categorized below from the feedback of the participants.

The following metrics of success were established:

1. Broadly define energy fundamentals for both installation and operational energy, in line with doctrine/policy. **#fundamentals**
    a. NUARI team established a terms and policy document to begin compiling fundamentals as described in doctrine/policy.
    b. Group agreed that much of the boundaries between installation and operational energy has blurred.
    c. Reconciling terminology across domains.
2. Define threats for Army energy **#threatvectors**
3. Define concepts for entry-level, mid-grade, and senior leader education and instruction, specific to their area of responsibility (AOR). **#training**
4. Identify critical support (AORs) for development, integration and sustainment for Army energy education and research programs (e.g. TRADOC, engineering schools, IMCOM). **#doctrine**
5. Understand the effects of energy sustainment, resilience, doctrine, environment and technology as they pertain to near-peer maneuver warfare.
6. Understanding the similarities/differences and opportunities for similar “problem profiles” in industry, non-military and military, as well as trends and emerging requirements. **#problemprofile**
7. Identify characteristics in existing behavior in Army, Marine, Air Force, Navy, Coast Guard, DOE, international and industry. **#missionbased**
8. Understand what other nations are doing (e.g. Russia, China, as well as allies).

9. Capture input from both official conversations and those occurring during breaks. The team was focused on this aspect and submitted comments and input from conversations over breaks and dinner, in a non-attribution format.
10. Encourage every participant to contribute to the discussion without a few individuals dominating thought process. The engagement was lively, respectful, and interactive. The backgrounds of the participants were chosen with this goal in mind and, by every metric, was successful.
11. Determine aspects of RT1 which should be replicated, and which scenarios can be avoided for RT2.
    a. The team was able to quickly assemble around a tight timeline and did so with grace and expedience.
    b. In the future, NUARI does not foresee timelines this tight. More participants expressed interest than could participate in such a short notice. We expect to send internal notifications for possible RT2 dates NLT 26 April 2019.
12. Address energy issues that occur beyond forward deployment, since Army is the largest consumer of energy across all services.
13. Include feedback from interested parties, including those who could not participate.
    a. Team is preparing an Out-Brief (external-facing document) for distribution to participants and organizations interested in ongoing engagement; we expect to distribute NLT 26 April 2019.
    b. Participants will get the opportunity to correct/contribute to the Out-Brief, before assimilation into the CGRS curriculum framework.
14. Quality feedback on survey, stakeholder interview and questions.
    a. Participants were interviewed during the stakeholder feedback session (SF1); feedback was captured and is synthesized below.
15. The team should not intend to silence the meaningful input from all participants, NUARI team included. The team kept it brief and to the point, while always trying to extract more insight and dialogue.
16. The team should be attentive to perspectives, regardless of agreement, and document what is heard throughout the process. The team submitted dozens of pages of feedback and notes for synthesis and inclusion into the CGRS academic framework.
17. Tangible outcomes that strengthen the research agenda for CGRS. Several topics were identified that were not initially included in the CGRS academic framework and are being studied for inclusion now.
18. Tangible lessons learned and a positive engagement for SMEs and stakeholders. The feedback was positive and extensive: special attention to the quality of participants and the impact of their perspectives on the agenda.
19. Desire for continued engagement and support for ongoing efforts.

a. Participants all expressed desire for ongoing engagement with CGRS and this process.

b. New relationships were formed: CGRS was invited by Advanced Energy Group to participate in the Washington DC's quarterly stakeholder engagements for inclusion of CGRS students and faculty.

20. A team effort with a team approach. The team supporting this effort did so rapidly (contract started 30 days before RT1), with professionalism and organization usually afforded only by the most highly-esteemed organizations.

Team Discussions

(Synthesize and Organize)

During Round Table #1 on Energy Fundamentals, subject matter experts convened to discuss the four fundamental aspects of energy: 1) sources of fuel; 2) energy generation; 3) transfer of power (e.g. transmission/distribution and mobility); 4) storage of power (e.g. dams, compressed air, batteries, hydrogen); and 5) other.

1. Sources of Fuel

The conversation regarding sources of fuel and relevant topics for study revealed that students should be taught the various fuels available to them, including traditional and non-traditional sources, the constraints and operational advantages of each, as well as the impact on the region/community in which fuel is being sourced or delivered.

#fuel

- Enhancements should consider maximization of available “fuel” (e.g. solar and wind) with a calculation of maximization of force per unit area, if there are only a few captive devices
- Extraction methods: mining for batteries – lithium, petroleum – oil and gas
- Geopolitics of the fuel extraction
- The economics of natural resources
- Potential operational gains or constraints based on fuel type
- Impacts of production or conversion at point of use affects capability
- There are trade-offs inherent in delivering fuel of distance (e.g. volume of fuel, costs, lives)
- Teach the basics of how fuel works (e.g. JP8 vs. diesel)
- Understanding the energy density of each fuel is important
- Renewables are often islandable and do not require imported fuel

Alternatives:

- Biomass residue (e.g. cellulosic conversion to jet fuel)
- Biomass feedstock can be locally sourced depending on the locale
- Vegetative residue, including sugar cane
- Solar, wind, hydrogen, nuclear, natural gas, propane, biomass, geothermal
- Solid state / metal hydride
- Alane: aluminum hydride
- Conduct holistic cost-benefit (total cost of ownership) of carbon vs. non-carbon fuels

Sourcing:

- Avoiding long LOCs (lines of communication?)

- Real-time visibility
- Different fuel for different applications

Planning:

- Use or create validated planning models
- Energy impacts everything
- Adjust for energy risks

Q: Renewables: how can they be used as part of the total energy solution?

2. Generation

The term generation references how energy is converted for use.

#generation

- The term “generation” implies electricity - how energy is converted to use is the act of generation
- Teach the difference between generation upstream vs. onsite / local vs. important / electric vs. non-electric
- Installation can have energy needs that range from critical to comfort. Not all generation needs to have the same resilience.
- Hydrogen can be used as gas, solid state: JP-8, diesel, natural gas, ammonia/biogas (from waste)
- Must be prepared to access generation without the use of traditional generators
- Study conventional (diesel, gas, fuel cells engines) and renewable (wind, solar, micro/hydro)
- Necessary to study the concept of optimization of power generation: how to minimize traditional fuels with the addition of renewable energy
- Is nuclear feasible: security, public perception, training, retention of manpower (more money in industry once trained)
- Fuel Cells can be used as generators, in microgrids, for soldier power, in vehicles (on-board generator capability), UAVs, and subs
- Students needs to understand financing, regulation, and pricing of energy generation options

#generation

- Nuclear – home station vs battlefield (portable and design for installations) OSD – small mobile reactor (RFP for design)
- Who do I train / where?
- Retain in the nuclear navy

- Solar
- Fuel cells – can run off most fuel-based sources of energy (multi-fuel vs. single fuel) which is better for the operation
- Efficiency of fuel generation – offset for environmental
- Generation is fuel dependent
- Who is the target audience – energy manager group (complex, detailed view of the energy piece)
- Mission training vs. general training (foundational training) – everyone should have one baseline
- Draw a line from home-station to around the globe – ideal conditions, unconstrained (how would you do it and what is the decision matrix? Decision matrix, if/then?)
- Generation options
- If behavior change is necessary, update Training and Doctrine with real-time information
- Training how I train them to implement, doctrine is how to gather a force
- Take a look at virtual forward operating base program (VFOB)
- Existing industry standards, apply and adapt to apply to expeditionary context. Is there an ASI or SI – Skill Identifier: program for leader priorities. May be able to include in officer training school
- Military capability – end state to achieve national security objectives. How it's sourced, converted, distributed and stored is choices made to obtain the military objective
- "I don't have a fuel problem; I have an energy source problem"
- Different operations depending on location. FOB base focused on centralized vs. home station
- Take a look at wireless power transfer – further distances distribution on a mission – the more you automate, the more difficult your cyber approach is.
- Continuum from installation to operations (home station to forward base). Evolving technology for centralized vs. decentralized. The mission needs to dictate what we can do, and we need to thoroughly examine these things based on the future fight
- Ground combat vehicles – optionally manned vehicles as "mobile microgrid"
- Constraints of distributed loads and architectures
- Where do we use electricity and where do we not?
- Need for an "anchor tenant" for non-traditional models, may be seeded by national security interests
- Define the strategy on O&M
- Avoid "corner cases" – not everything carries over

- Study exportable power to vehicles (mobile microgrids)
- Some bias is based on residual memory ("folklore") rather than truth
- Different storage chemistries for different environments. Super caps – tactical vs. immobile.
- Future fight needs someone to calculate optimization
    - Adequate planning – doctrinal planning to include energy as a mandatory consideration – total mission weight
    - Environmental impact
- Hot water is storage. Take a look at hybrid-electric helicopters
- Use storage for more than one thing: repurpose it
- Hot water load: training the future leader to think of energy as critical for foundational and some is comfortable to keep in the mindset
- Include the study of flywheels and thermal storage

Q: What effect will mobility have on energy generation, including nuclear mobility?

Q: What is the effect of distributed energy resources on traditional generation models?

Q: How should future generations manage the policy development regarding foreign sources of energy?

Q: What rules of thumb do we need to teach? We think of the exceptions, but the soldier needs to be trained on the rule of thumb. What would we institutionalize?

Q: Is there a matrix which can help authority choose which generation is available?

Q: Tactical Power - planning priorities - How do we translate this to the operational army?

Q: Energy Transfer – central or decentralized?

Q: How do you future-proof generation decisions?

Q: How does all of this work in a multi-domain framework?

Q: How do I do all of this in a multi-domain framework?

3. Transfer of Power

The movement, transfer, or mobility of power changes the way that power is planned for, consumed, managed, and distributed. Collaboration revealed there are required areas of study including wireless power transmission, above- vs below-ground wired transmission, and the effect of distributed networks on the cost-benefit ratio of power transfer in order to determine the overall effect of how these choices *constrain* or *enable* capability

#transfer

- There are growing vulnerabilities within 5G environments: energy pathways from generation to distribution, between distribution and consumption, creates vulnerabilities

- Crowd-sourcing should be researched for new technology
- See: Sofwerx model
- There need to be methods to calculate effectiveness
- Things to consider: financing / regulation / pricing
- Need to consider the difference between above-ground and below-ground transmission for shorter distances (cost trade-offs)
- Study centralized distribution vs. distributed (e.g. microgrids) as well as wireless transmission
- Supply chain is an important aspect of logistics planning that should be considered when reviewing transfer of power options
- Teach the rules of thumb regarding losses incurred during energy transfer over distances, or when changing modes of transfer
- Study distribution automation technologies
- Review equipment standards for transformers, capacitors, inverters, power electronics
- Power transfer requires a hard look at energy agnostic microgrids that are built with relative simplicity = no need for proprietary solutions
- Sites should review their access to transmission and distribution feeders: are they onsite? Are there multiple feeders?
- Natural gas and oil pipelines are an example of power transmission
- Vehicle delivery of power is also transmission and should be considered as such
- Research the (DoD) SPIDERS grid
- Study how transfer methods change the designs (AC vs. DC power / high vs. low voltage) and how these choices constrain or enable capabilities

4. Storage of Power

The way power is stored, and the cost and logistics of doing so, has dramatically changed in recent years. What was once experimental technology and chemistry is now used in everyday commercial sectors.

#storage

- Facility scale power requires much larger storage: 1-3MWh being the average for facilities
- Students should understand storage density and the distribution of that power
- Topics yet to be understood are financing and regulation of storage devices
- Pricing of storage tends to be a barrier
- There are multiple forms of storage including fuel cells and microorganisms (biological) which should be studied

- Study various chemical energy storage
- Baseline understanding of storage chemistries, the rate of change and efficiencies, and the best cases for each; easy starting position: lead acid, flow, lithium batteries, flywheels, pumped hydro, sodium
- Analyses should be conducted to compare and contrast storage efficiencies based on mission and locale (battery vs. fuel cell vs. hydrogen)
- Study advanced storage: kinetic, vehicle to grid, thermal, new honeycomb large vessels for hydrogen storage
- Battery variables:
    - small, medium, large
    - renewable / disposal
    - compare needs with power requirements
    - mobile vs. static
- Study of onsite storage in a non-fuel form as a means to enhance resilience
- Study how storage changes the architecture of energy systems
- Study should be given to the implications of storing energy across multiple modes of storage

Q: How are we managing the stockpiles of batteries in preparation/anticipation of new types of energy (e.g. types of batteries, energy sources)?

*Other topics are included in the section 5 below.

During Round Table #1 on Energy Fundamentals, subject matter experts expanded the conversation on energy fundamentals to the potential risk and threat vectors concerning the fundamentals: 1) cyber; 2) physical; 3) acts of nature; 4) supply chain risk; 5) other.

1. Cyber

Mitigating cyber risk is a moving target for every impacted sector. The ability to rebound from attacks, or breaks in normal operation, is a requirement of resiliency.

#cyber

- The threat is access allowed by an insider: curriculum should include study of multiple lines of defense such as physical and digital authentication
- Special attention should be paid to the ability to infiltrate third-tier supply chain vendors with cyber vulnerability
- Disrupts smart city architecture (e.g. the effect of cyber on electric/autonomous vehicles)
- Cyber threats to energy infrastructure, supply and logistics should be simulated/modeled, across all domains
- Identify indicators of compromise
- Create incident response - enterprise-wide for energy

- Identify threat actors, types and objectives (e.g. nation-state, criminal)
- Study trends in energy attacks: what to expect and where to retrieve information
- Identify what is available to respond: prepare, rehearse/exercise, mitigate, resource
- Telemetry points
- Control systems should be understood and how to build secure interconnectivity; controls can be compromised (individual devices, whole systems)
- Control systems include interdependencies of energy, telecom and water infrastructure: linked systems onsite (hack one, affect all)
- There are threats in components that can be sourced, or sub-sub-sub sourced, anywhere
- Look at malware: individual actors can insert malware (e.g. Chinese woman in Mar-a-Lago, Florida)
- Need to future-proof cyber security through evolution
- We have an over reliance on the internet (e.g. banking, privacy issues)
- ICS cyber; spoofing and cloning MIL systems; PNT attacks
- Need holistic security training
- Risk: embedded zero-day program in equipment to cause disruption (e.g. meters at switchgear); cyber can take out a large portion of the national grid
- Attacks on vulnerabilities within commercial/public utilities compromises military ability to project power (“power projection”)
- Power of social media to influence and cause deception
- Network visibility is difficult to determine: do you know what is plugged in and where?
- Espionage / exploitation / spear-phishing / OSINT / domain spoofing / credential harvesting / ransomware / insider threat
- Outdated technology and implementation/sustainment models
- Risk Management:

$$\frac{\text{Threat + Vulnerability + Knowledge}}{\text{Controls}}$$

Q: What are the global, national and local threats?

Q: How do we identify the threat and how do we develop a risk management/mitigation plan?

Q: How do we avoid a financial meltdown if the grid is compromised?

Q: Are we “out-educated” by our adversaries?

Q: What hardened architectures can be deployed to support infrastructure and security?

2. Physical Attacks

Physical attacks include disruption to access, service, and other energy essentials through natural and manmade mechanisms of a non-virtual nature

#physical

- Need for disaster modeling and simulation training
- Categorize types of threats, patterns and trends
- Rehearse, respond/recover, mitigation and preparedness
- Identify the cascading effects of physical disruptions
- Power surges
- Asset maintenance
- Predictive analytics
- Digital twins as resiliency and redundancy
- Review destruction potential of links and nodes, wires and devices (substation to panel box)
- Review interdependencies of water and wastewater treatment plants and other critical infrastructure (e.g. water and wastewater denial)
- Lone wolf attack - attack on visible systems; small arms fire damaging T&D infrastructure
- Disruption to ports and surrounding infrastructure
- EMP (electromagnetic pulse)
- Critical substation attack
- Targeting energy first responders
- Targeting of refineries, pipelines, shipping
- Target PNT
- Critical infrastructure attacks (ports, airports, nuclear power)
- Anti-satellite jamming (or kinetic)
- Teach preventative electrical system protection and hardening approaches
- Design smart surveillance systems that can inform before physical threat occurs
- Risk: aging infrastructure and legacy systems without accreditation
- Single points of failure at every point (fuel, gen, trans, storage)
- OSINT / gunfire / intrusion / surveillance / theft (copper) / vandalism / espionage

Q: How do we identify and provide the proper network security across the installation (NIPR/SIPR)?

3. Acts of Nature

Acts of nature have incurred incredible costs in recent years, as climate swings have become more common and extremes more regular.

#actsofnature

- “Fatter tails” of logistics, from climate change
- Partner with energy labs to provide unique training, evaluation and experience with modeling and simulation
- Extremes including hurricanes / fires / earthquakes / temperature
- Flooding is an increasing risk to power continuity, especially in coastal areas (due to rising sea level)
- Acts of nature affect our ability to support ground-based defense systems
- Energy denial during major event can be compounded by cyber and physical attacks
- Extremes are becoming more common and more expensive: invest in technologies and planning
- Up front investments should incentivize investment in technologies that can mitigate risks of climate change, rather than the reactive element (e.g. government pays, insurance pays, after the fact - rather than incentivizing resilience from the outset)
- Curriculum should include understanding of risk management (e.g. risk likelihood + risk impact)
- Need to understand the location and how to build redundancy that bounce back after natural threats
- Review long-term climate change risks and threats to energy systems
- Teach an understanding of the temperature effects on energy systems
- Ensure that equipment specs tolerate natural environments if it is housed indoors - transit and risk of exposure
- Understand coordination models with DSCA - defense security cooperation agency
- Begin looking past the 100-year event planning, into the 500-year event
- Pacific-rim of fire earthquake
- Failure-proof: do not build critical facilities near the coast (e.g. Fukushima)

4. Supply Chain Risk

Supply chain risk has come under careful scrutiny and impacts every stage of energy resilience

#supplychain

- Cyber attacks take out large-scale systems like transformers
- Kinetic attacks

- Cyber intrusion and misinformation
- Fuel disruption
- Power to manufacturing facilities can be compromised
- Design needs to include the policy perspective (expound?)
- Lithium ion and metal-flow is largely sourced from Asia and/or developing countries
- Curriculum should include the geopolitics of supply chain management
- Understanding of product vs. component
- Analysis needed of manufacturing supply chains
- Materials scarcity may be an issue in coming years
- Study global energy markets and the relationship to potential for conflict
- Address resilience frameworks for assessment and analysis
- Study sources of conflict in the joint operational environment
- Understanding that supply chain is more unpredictable due to weather, especially in austere environments
- Need to understand the time to replace critical components (substations) as well as the time to gather critical components (including rare earths and “clean” parts)
- Counterfeit pacts / malware / obsolescence / foreign dependence
- “Island hopping”

Q: Who do we provide with information? How does that affect system designs and parts, information aggregation?

Q: How do we contribute to standardization across supply chain?

Q: How do cyber attacks threaten the supply chain and how do we mitigate that threat?

Q: How do we best test products before use?

Q: How do we ruggedize the entire supply chain?

5. Other

Many other topics were identified in the Round Table; some expand on the topics as noted by #hashtag below, and others can be used to analyze CGRS curriculum through these perspectives.

#fundamentals

- Teach the basics: civilian energy, power (kW) v energy (kWh)
- Teach how to make/create the energy needed if generation requires a certain fuel
- Once fundamentals are established, update regularly and continuously as environments and models change

- There is a nexus between energy, water, waste, and waste-water: the interdependencies should be studies

#publicprivatepartnerships

- Business relationships can incur risks in defense and national security during mergers, acquisitions, and when businesses close their doors
- Training programs which include the realities from public and private entities, done in tandem
- Work together to assign value to non-monetary risks, especially when justification of funding is required

#threatvectors

- Help to identify current obstacles preventing the adoption of renewables and alternatives
- Pricing of storage tends to be a barrier
- Chain of command informs emergency supply chain
- Decision matrix needed to inform technology availability and match it to location and threat type
- No proactive approach for fast delivery of assets during a threat scenario (outside of traditional fuel and generation)
- Economic security is a priority and includes energy security / resource security
- Bureaucracy policies, funding changes - add risk
- Major biological warfare threats: need for antidotes manufacturing
- Rapid change in technologies: Moore's Law does not slow to the DoD acquisition timeline
- Standardization is missing
- Current view of energy access as foundational to missions is missing
- Power projection (DoD term) is the capability to view weapons systems from factory to fort to port - port to foxhole
- Age of the workforce, shortage including electricians, National Guard workers
- Gap in knowledge over engineering systems versus field capabilities
- Ineffective utility recovery plans at installations: cannot be executed / incomplete / out of date

Q: The larger onsite system, the larger the target?

Q: How do we match DoD acquisition timelines with Moore's Law? How do we teach / train in real-time?

#training

- Train for reality, not just requirements
- Not a checkbox system
- Reality of resources available in the field
- Reconcile training with manpower capability and skills
- Need more training for biological warfare threats
- Human error comes down to training in most cases
- If systems are too complex to operate, no one will (“the ignorance of complexity”)

#culture

- There is a gap in the old way of thinking versus always adjusting technology; model of thinking needs to be addressed

#doctrine

- Geopolitical risks should be weighed when reforming doctrine around energy access issues

#riskmitigation

- Involve executives in the process
- Create network segmentation / firewalls
- Take accurate inventory of control system devices
- Minimize / eliminate ICS exposure to external network
- Need role-based access

#interdependencies #interconnected

- Water shortages and the impact on energy production
- Socio-economic factors of fuel / generation / storage / transmission
- Environmental impacts: e.g. mining, exploration

#missionbased

- There is a need for an understanding of the mission-based criteria - matrix, flowchart, if/then
- Energy as an enabler, a capability and not a destination
- “We pay for light, not for power”
- Include factors of influence (e.g. security for fuel transport, distribution, etc.) in mission profile.

	Garrison	Stability Ops	MCO (resilience, sustainment, mobility)
Fossil Fuels	Y	Y	Y
Solar	Y	Y	
Wind	Y	Y	
Natural Gas	Y	Y	Y
Hydro Electric	Y	Y	
Geo-thermal	Y	Y	

All depends on the nature of the mission:

- Policy, resources, priorities, stability of area are filters within which to view the mission capability (e.g. FOB vs. mobile)

#systemsperspective

- Policies and processes need to be designed to how a system will be used rather than how one would like them to be used
- Policies and processes must be reconciled with reality (mission-based reality)
- Review continuously as there are changes/impacts to fuel/ generation/ transmission/ storage

#standards #bestpractices

- Product coding and installation standards needs to be established and better defined/ taught

#multidomainwarfare

#redundancy

- Need to be able to teach: how much, how and where?
- Where: Is redundancy best done on primary site, or off site?
- How much/How: Based on mission: if/then for redundancy planning/metrics/operations

Q: Is there an existing tool to apply risk/critical “triage” metrics to sites/missions which could help the users and planning organizations determine the appropriate levels of redundancy planning?

Q: Should there be a redundancy planning “handbook”? For example, the primary generator on site has two generators: one for pieces/parts for maintenance, and the other for backup (redundancy). Is this the best application of redundancy planning? How much, when and how?

#planning / #prepositioning

- Variability of supply (vs current idea of steady-state supply)

Q: Wargaming: there was mention of failure rates of wargames when success is determined based on energy resources not being readily available. Is this something we can access?

Q: Is there a way to wargame/test resource and logistics variables for missions, CONUS and OCONUS?

#technology

- Tidal energy advances are looking to invest in military installations
- Need more application of R&D technology in our grids
- Biomass, food waste, algae, to hydrocarbons as seen here:

$CO_2 + H \rightarrow CH_2 - R$

Air + water ---> Fuel

- Microorganisms as a form of storage (biological)

Q: Are we over-complicating technology for workforce (civ/mil contractor)?

Q: There was a comment about the “state” of current energy systems (white cards: other); anyone want to expound?

CGRS: Evaluate Adjustments to the Curriculum

This template will be used to run an internal meeting with Norwich University colleagues (in engineering, science, and business programs) to develop the following in support of the CGRS energy track:

1. Objectives
2. Materials and
3. Resources

FAA Case Study

1. Biggest obstacle for FAA: cost-benefit; sites for solar are inhibited based on the hurdles of the sites. People do not know the benefit and the future-proof; potential threats or environment when the entire grid is out.

- Cost benefit and a comprehensive plans and areas of applicability. If/then scenarios of the filter for when and where these things will work. “Investment is finite.” The winner is going to be the one to work around the ordering the problem – it is not happening on a scale. Non-optimized solutions.
- Carbon tax worked 30 years ago – polarization reduces the activity. Everywhere decides to get to green rather than thinking it.

2. Understanding the technology; having a suite of tools available so they can understand the technology from multiple tech; fuel cells vs. batteries. The chemistry is important to understand. The physics are necessary: more heat when you do x. Controls class to do the swapping of the matrix. Tools to be able to select. Understanding the basics of what software can do – then you can understand that you can make or find the software. What is fuzzy logic? What does AI mean

right now because it has changed? The program analysis part has to be included – not how to go way-around the system but to be innovative within the system. If/then scenarios.

- It is great to teach the students, but where is the resource that is accessible to DoD and entities that can come back to the source? Where does it live? The EPA has a huge amount of data for vehicles – collection point of where that research lives. Municipalities are struggling all over the place to buy one bus. No master planning before they start spending money. Budget irreconcilable with the "mission" or the target of the municipalities. If there isn't a national landing pad of professional staffers, this is going to crumble.

Norwich Interviews

- Edison electric works with smart cities, smart communities. Biggest obstacle to energy resilience for Stationary Bases vs. Operations is the lack of dedicated manpower—military versus third-party contractors. US has been selling off anything that is not core operation. "Let the utilities, etc. do it," let them upgrade, we don't have to worry about maintenance, operating 24-7, forward operations versus on-base tradeoff. Only have so many people. With resilient cities there are so many more issues because they have so many more constituents. Parallels with the military, but not completely the same. More big data in resilient cities, many disparate data sets e.g. 20 (city) versus 5 (military base). Utility perspective — biggest obstacle from the US perspective, keeping up with the cyber threats, as policies change (particularly environmental ones), assets can become stranded. Multiple metrics. Definitions of resilience — adaptation, bouncing back.
- All utilities have 50-year asset management plans, which includes security threats. On base energy and water distribution system. Different ways to produce electric, thermal and process (vehicles) energy you need on base. Design and support network.
- Definition of resilience — North American Electrical Reliability Council (bulk power) information from NERC FERC, they have a framework and metrics to track
- Big fan of US Energy Information Administration (EIA) — DOE funding — tons of data, Energy trade associations, public documents, International Energy Agency, LNG, Oil, Electricity. EIA conferences.
- New employees receive training, Electricity 101 on the website, everyone trains in their particular job function after the fundamentals. Training and continuing education opportunities, conferences to stay up on latest trends. Discussion of intermittency — teaching about clouds/solar and wind. Threats of solar panels, wind turbines. You can't hide them!
- Wish list — dedicated resilience SME at the installation and operations, because it is so critical. Might not be able to show a traditional return of the resilience specialty. How to measure the benefits of resilience? FL example hardened the system — 5 hours instead of 12 days.
- Team teaching classes, narrative economics, qualitative data that resonate with students. Data centers have redundancies N+1, N+2, N+3. High stakes.

- Smart cities, Columbus OH, DOE Outside of competition. Some have military applications, e.g. sensors, but not smart street lights.
- Aligning leadership priorities for funding is key. Need leadership to understand and support it at all levels (energy managers, commanders, Pentagon and HQ Service managers, Congress, DOE, State agencies, local and state public safety managers, local councils/boards, etc.). Address siloed thinking.
- Need to understand the value of resiliency, very hard to make the funding case for energy systems if the basic electric and natural gas grid infrastructure is super reliable
- We had one critical infrastructure owner say, “hard to make the case to my board to invest millions in onsite system if my facility hasn't lost grid power in 25 plus years.”
- Updated and ongoing technical training - some energy managers are stuck in an old mindset - diesel genset are the only option for backup. Need refresher on CHP, district energy, modern microgrid controllers, solar with storage, V2G. Study tours of actual facilities useful.
- CHP microgrid design - procurement, operation models. Microgrids as a service/PPA.
- Teach about Energy Assurance Plans at state, local, and regional levels. Role of ESF-12. Role of State Government during energy emergency events. How coordinate between federal/state/utilities/fuel supply logistics. Role and method of mutual assistance agreements and deployment.
- Utility regulatory environment, regulated and unregulated utilities, role of PSCs, federal master contract vehicles (how to expand contract vehicles to support private partners as well?).
- Understand capability of National Labs to conduct resilience assessments for critical infrastructure.
- Teach about black start and PJM, role of hydro/nuclear. Also basics of PJM and other grid operators, FERC, NERC. Basics of fuel pipeline infrastructure, fuel terminals.
- Study FEMA pre-disaster mitigation program, technical assistance and funding.
- Understand how communities can work with military, including US Army Corps to do studies and line up infrastructure investments.
- Understand deal flow, deal structure, options. Sample contracts/contract bridging/riding. Basics on project development stages from pre-feasibility to design/build.
- Various decision support tools and models (like DER-CAM, etc.).
- Consider options for water utilities to treat and pump water during a major blackout.
- Take a look at Prime Power Battalion at Fort Belvoir; embed students for hands-on training.
- Review EMP threat and options for protection/hardening.
- Participate in tabletop exercises funded by UASI/ETOP.

- Tour PJM Operations Center in PA, and Princeton University Microgrid.
- Understand capabilities of the regional DOE CHP Technical Assistance Programs.

Lessons Learned: The base is prioritized for first delivery of electricity, once restored, although if the transmission and distribution system is disrupted, there is no guarantee of delivery of electricity first, since the whole of T&D will need to be online.

Stakeholder Feedback #1 Questions

1. What would you identify as the biggest obstacle to energy resilience in military installations / resilient cities / specific industry approaches / in general?

- Reticence to move ahead with resilience and assurance of projects due to cost-benefit uncertainty. May not understand life-cycle payback of onsite resiliency assets.
- Not cognizant of cost of mission obstruction (no applied value assumption) or not operating without electricity.
- US military policy is to deal with extreme events.
- Cities in the US and abroad have taken initiatives to smart cities: safety, backup systems and plans.
- Slow indoctrination of middle ranks in embracing change - not so in smart cities; they are hiring in people who will get things done.
- “Future-proofing” master plans with appropriate models to support innovation as well as sustainment.
- Information or lack thereof.
- Expectation that we do not have limited resources and that their reliability is 100%.
- If people do not feel or understand the consequences nothing will change.
- The general perception is that we do not have to be optimize our use of resources because we will not run out. The expectation is that whenever you flip the light switch the light will turn on, i.e., that it is possible to rely on electricity 100% of the time. The perception is that natural resource reliability and availability challenges, as well as negative impacts of climate change are problems that are “light years” away. Therefore, the biggest challenge will be to change these expectation and perceptions with information. Additionally, the challenge will be to influence people’s behavior (e.g. manage resources in an optimal manner).
- Biggest obstacle is “Ignorance and Financial Assets available” Because of insufficient resources, there is a lack of expertise and staff from Army down to the installations.
- Define it and design to it. How do you measure ROI and tie into mission and institution? What is the risk that I am going to buy down?
- Policy and Doctrinal definitions are still not institutionalized. 14 Day resilience versus what is really required and all the factors, impacts? Needed to place starting place on 14 days (start point).
- City approaches to resilience should be studied for best practices, lessons learned for Energy Resilience in Installations.
- Identifying. - Measuring - Tie-in and programming
- Why that connects to an installation.

- Different definition of resilience - resilience comes down to a feeling.
- Measuring resilience – relative.
- Need to put a number on it.
- Program means pay - what does $10M.
- Cities have a better handle - resiliency for infrastructure valued / Boston and New York City great case studies.
- Clear financial cost.
- Training engineers vs commanders.
- Most important energy fundamentals.
- Generation, Transfer and Storage.
- Mission Assurance Assessment Framework - modify critical infrastructure assessment.
- What are my metrics in army at various levels and why?
- Needs to be implemented at the beginning and more integrated.
- Core of Engineering Continuity Plans.
- Master Planning - modernize master planning.
- Military bases as extension of the weapon.
- Events, engagements, conferences - partnering with industry and stakeholders.
- ERDC - DOD lab under Army Corps USACE R+D - infrastructure, energy and environmental.
- Army Futures Command.
- Access to the technology - using the technology – do not be prescriptive, be descriptive.
- Money is stove piped.
- Have Deputy Assistant Secretary of Army come to Norwich.
- Other - train leaders to navigate the system - before you can optimize.

2. What kinds of energy fundamentals should be taught / considered by teams that are preparing asset management plans for your installations? (This could be military or non-military.)

- Curriculum: acquisition modernization approaches to long-term goals. RFPs are reflecting demand signals for change. But it needs to be studied. Army $7B 20-year IDIQ to modernize Army bases: four tech tracks (wind, solar, geothermal, CHP).
- Nuts and bolts of non-traditional energy systems: need to include all-of-the-above energy options.
- One of the challenges we face is that people do not necessarily understand the negative consequences of natural resource mismanagement. To address this, we should train the

students so that they are able to identify the consequences of their actions (e.g. the impact of their decisions in regards to energy systems).

- For progress to be made there has to be a top-down buy-in within organizations. It is important that the leaders not only support, but also model the implementation of optimal use of resources.
- One way to impact behavior is to disseminate impactful information. Including information that makes the timescale that we can expect climate change to negatively impact us more tangible.
- Future Ops: WE build definitions for future requirements.
- 85% of the army today is same as that which we will have in 2040. Consumption will increase as we add capabilities. We need to use (**technology/equipment) differently than we have been using, AKA more efficiently with more knowledge on available assets and not being 'lazy' to upgrade ourselves on better use of the existing or new technology or equipment.
- Decrease consumption, energy being as a component of a full picture. Army is a problem... how we use stuff, not consumption. We teach to shoot, not how to save ammo. We need to develop a different view, a different prism and use energy as enabler for greater good.
- Change how we approach energy from "decreasing consumption to energy is one component of military power."
- Source/Conversion/Distribution – all need a different view.
- Installation – adapt at local / national / global principles.
- We talk about energy systems only when they are an issue, assuming it is always going to be there (like atmosphere), but what about thinking pre-emotively forward?
- Considerations for curriculum:
    - Understand impacts of geopolitical impacts and threats to installations and energy
    - Understand how to lead change
    - Integrate case studies and labs – example of case study for city resilience is Boston and New York from Hurricane Sandy. Impacts from disaster and these city responses to mitigate, recover and build resilience
    - Understand DOTMLPF in planning process for installations. Leader Development the L in DOTMLPF – TRADOC and Army way to validate changes.
    - Do we need energy as baseline education factor for ROTC and Army training/ education?
    - Top three energy fundamentals – Generation, transfer/conversion, storage.
    - Integrate cadets and future leaders into expeditionary experiences at ERDC, Corps of Engineers and HQDA. Internships – Apprenticeships. Policy and

research. Use as means to inform senior leaders of disconnects between labs, HQs and Army (note: NU After Next Program).

- Export curriculum to other schools and expand (note: Senior Military College Consortium and WestPoint collaboration ongoing in cyber).

3. What energy resilience frameworks are you currently using to secure your installations and operations?

- Good collaborations between bases and advocacy communities.
- The Association of Defense Communities (or "ADC") promotes and awards people. ADC is an extraordinary non-profit grouping of nearly all the U.S. military bases and facilities on the one hand, and their adjacent communities - cities, towns - on the other. ADC promotes cooperative arrangements between bases and their next-door communities, including Public-Private Partnerships (P3's) - to share resources such as electric utilities/power generation, onsite renewable energy, fire stations, first responders, water treatment facilities, and so forth. This saves money and provides back-up security and mutual support in the event of natural or man-made disasters, e.g. power outages, flooding, forest fires, etc. The annual and semi-annual ADC conferences spotlight awards given to the most successful base-community partnerships, in order to drive replication of best practices and innovation in military-civilian collaboration.
- Limitation if there is a catastrophe, ensure military basing comes first: community maybe short-changed. Overall, though, flexible and cost-savings is best when demonstrated through shared efficiencies (as example of community-military collaborations).
- The projects focus on reducing the organizations energy need without changing the functionality of the environment that the organization operates within.
- Energy Resilience: Community engagement – compound a complete picture. What is Definition of Resilience means for everyone? Army Definition is "quote on failing gracefully while maintaining minimum required."
- Installation Status Report will show what we make people focus on. Energy is only ONE component of the process... it has to be. Enabling infrastructure is a part, but we need to also show how it impacts humans and the mission. Consider using something like the "City Resiliency Index".
- What are top two Energy Resilience?
- DoD Mission Assurance Assessment framework: not how it is currently implemented, but as a start point integrated into planning and master planning.
- MAA done ad hoc against specific threat, not integrated into the holistic and comprehensive planning.
- What metrics am I using in energy resilience?
- Installation energy design must be integrated from the beginning of planning and comprehensive.

- Corps of Engineering continuation of operations planning approach.

4. What training programs or online resources would you recommend your employees take to help strengthen their understanding of energy fundamentals?

- Teach all the energy options.
- Major organizations exist (IEEE) with training programs of their own. Top five or ten organizations already offer certification courses available for engineers.
- No need to reinvent the wheel--coordinate with those orgs already doing it.
- Reference Society of Army Military Engineers.
- Simplify and encourage post grad continuing education. “Simple, non-technical version of the NPS course.” It needs to be condensed time wise, to engage and encourage insights into problem. Support for the internal growth within organization. Because of how long training takes, more money will not solve the “undertraining” problem. Trim back training requirements to cover all that needs to be in a year. For the operational side, consider on-line training on MILBook and MILSuite.
- Corps of Engineering continuation of operations planning approach.
- Modernize master planning to meet installations as a weapon system and multi-domain operations. This is currently not resourced. NDP.
- Homeland no longer a sanctuary from threats.
- Air Force a model for installations as a weapon system.
- INCOM to AMC important change.
- Review what training is currently provided by ERDC, HQDA, other.
- Services, industry, engineer school, etc.
- Attend conferences – learn OJT is the process as HQDA – not formal training/education program.
- Partner with stakeholders, open requirements for industry – this is a change process and hard for Army/ DoD to do. Aircraft carrier.

5. What kind of support does your organization provide (monetary, time, professional development opportunities, etc.) to ensure that your employees are current in their understanding of energy issues?

- Allow people to take time away to have intensive immersion training.
- Operations plans (OPLAN) should assign everyone a role.
- The organization helps clients transition to new technology (i.e. new lighting systems). The organization helps them identify the best funding option. In some cases, that is the utility bill savings that occurs after the transition to the new system. In other cases, the organization helps the client secure rebates from a third party. Sometimes the rebates fully fund the systems transition. In addition to help identify and/or secure the funding, the

organization designs the system and installs it. For the initial client meetings, they provide visual of the impact of the energy savings. Those visual show the impact of the CO2 reduction that comes with the energy saving. Examples of visuals: the number of cars that release the same amount of CO2 or the number of trees that would reduce the equivalent amount of CO2

- Organizational Support: Annual Energy Manager Training. The Energy Exchange. DLA Fuels Conference. But is it the right and most effective training? Time issue not a money issue.

6. Of all the things that would help you reach your energy resilience goals, what is included in your "wish list" of items, including technology, training, upgrades to solutions or programs, etc.?

- Connectivity between base engineers + utility + decision offices whose decisions are vital to recovery. Katrina showed Louisiana government and related offices there were dysfunctional in dealing with FEMA and National Guard Responders
- U.S. should be looking at expertise and solutions elsewhere around the world (e.g. Netherlands re expertise on water).
- Cultural shift is critical, and it has to start at the top.
- Direct messaging or PSA announcements are missing. Equivalent to the cigarette campaigns.
- Wish List: a COMMONALITY – "like a USB port… when plugged in, works everywhere." [Wish List] Open Architecture and open standards to make sure everything works everywhere interchangeably. Trade Schools = train people. Doctrine teaches how to fight. Higher education, how to THINK.
- The challenge is how to converge Power and Energy together to solve problems (versus electricity).
- Cannot get there far enough, fast enough. And it's too costly. We all have the same problem. Just different outlooks on the same issue.
- Access to technology. Getting technology and using technology.
- Don't be prescriptive. Hard to do.
- Big problem in procurement. Different buckets of funding – MILCON v alternative funding.
- Need to train leaders / officers to navigate the system.

CGRS Analyses

Overall CGRS analyses notes are included in this section. A copy of the draft roadmap utilized at RT1 is attached as Appendix A.

From a CGRS energy track and curricular development perspective, the metrics of success laid out in the first part of this report, were applicable in the following ways:

1. A general consensus on definitions, and inter-changeability of terms used in installation and operational energy resilience, is a key first step in designing or enhancing relevant curriculum.
2. Recognizing that curriculum for the different entry points will still require the coverage of a certain amount of fundamentals, followed by specialized materials that may be level-specific.
3. Developing educational modules that cover not only the fundamentals of energy, including the source of fuel, generation, transmission, and storage; but that also integrate the impact of cyber and physical threats and vulnerabilities, including natural disasters, and the impact on the overall energy supply chains.
4. Educational pedagogies on energy resilience should be applicable across all military services, and pull from non-military sectors for a deeper understanding of fundamentals and beyond.
5. Energy resilience coursework should include at minimum an introduction to how other nations including China and Russia, manage their energy resources and are developing their own energy resilience, and impacts of their strategies, policies, and technologies on the US installation and operational energy resilience.

The engagement during RT1 was productive for the CGRS energy track and curriculum development in the following ways:

1. Each discussion on the fuel, generation, transfer, and storage raised a large list of topics that would benefit an energy curriculum. Some of these topics are covered within specific classes, even though the focus is purely on the concept, and its limited technical application. Even though instructors may mention the relevance and use of the technology or how the fuel, storage, etc., apply in a military installation or operational, this is a limited conversation, when it happens. Using the experts from the Round Table and their networks, instructors involved in the CGRS energy track will be able to develop specific examples, and case studies, including successes (for example where certain fuels were swapped from traditional to renewable sources), and lessons learned for deeper student engagement and understanding.
2. The discussions on the cyber-physical-acts of nature-supply chain conversations are key in the CGRS plan to provide a holistic energy resilience education at all levels. As these topics are not traditionally covered in engineering courses that cover energy resilience, but that are key in the military installation and operational side (as repeatedly discussed during RT1), it is imperative that CGRS expand our outreach efforts to colleagues who cover these topics, even if they don't typically cover these in the context of energy

resilience. Once again, the experts at the Round Table, their networks, and our partnerships will allow for the development of a robust curriculum that includes an appropriate level of detail on these topics.

3. The specific lists that were developed for each of the specific topics will be discussed internally at a meeting being convened by CGRS and NUARI between Norwich colleagues who are involved in teaching many of the classes that include these topics, as well as local and regional experts, who could not attend RT1 in Washington DC, and will have helpful guidance on developing the curriculum enhancements that emerged following the discussions of April 3 and 4, including instructional pedagogies, content specific additions, and opportunities for students to engage in hands-on experiences. A tentative list of the May 9 invitees is included, and the May report will include the report out on the internal meeting.
    - Stephen L. Fitzhugh, Electrical and Computer Engineering
    - Karen Supan, Mechanical Engineering
    - David Feinauer, Electrical and Computer Engineering
    - Michael W. Cross, Electrical and Computer Engineering
    - Michael W. Prairie, Electrical and Computer Engineering
    - Martin G. Rolland, Mechanical Engineering
    - Edwin R. Schmeckpeper, Civil and Environmental Engineering and Construction Management
    - Moses K. Tefe, Civil and Environmental Engineering and Construction Management
    - Laurie D. Grigg, Earth and Environmental Sciences
    - Matthew T. Bovee, Computer Security and Information Assurance
    - Kahwa C. Douoguih, Business
    - Scott Nelson, NUARI
    - Philip T. Susmann, NUARI
    - Karen L. Hinkle Biology, Associate Provost for Research
    - Elizabeth A. Gurian, School of Justice Studies
    - Amy Woodbury Tease, English, Director, Undergraduate Research Program
    - Gisladottir, Viktoria R CIV USARMY CEERD-CRREL (US)
    - Richard Manzano, Project Director, Mission Command Platforms, US Army Futures Command
    - James Goudreau, Head of Climate, Novartis (USN (Ret) Former Acting Deputy Assistant Secretary of the Navy for Energy
    - Allison Ross, Energy Consultant, Efficiency Vermont (working with the Vermont Guard)
4. One immediate follow up on recommendations for the energy resilience tracks came from David Heap, a participant in RT1. David previewed the Norwich University course catalogue and presented a vision with specific courses attached to two tracks as shown below in figures 1 and 2.

Energy Resilience - Technology Track			
	Credits	Code	Title
Eng	3	EG 203	Materials Science
Civil	4	CE 220	Introduction to Environmental Technology
	4	CE 421	Environmental Engineering
	3	CE 460	Construction Management
Elec	3	EE 315	Electrical Energy Systems
	3	EE 459	Electric Power Systems
Mech	3	ME 370	Mechanical Systems Design
PM	3	EM 461	Project Management
Env Sci	4	ES 270	Fundamentals of Environmental Science
Cap	3	---	Energy Resilience

Total Hours: 33

Figure 1. Energy Resilience – Technology Track

Energy Resilience - Management Track			
	Credits	Code	Title
Eng	3	EG 400	Design Thinking and Innovation
Acct	3	AC 201	Introduction to Accounting and Financial World
Comp Sci	3	CS 300	Management Information Systems
Comp Sci	3	CS 407	Politics of Cyberspace
Eng	3	EG 350	Engineering Economics and Decision Analysis
Mgmt	3	MG 309	Management of Organizations
	3	MG 351	Organizational Behavior
Poly Sci	3	PO 106	Introduction to Public Policy and Administration
Psych	3	PY 232	Engineering Psychology
Socio	3	SO 330	Military Sociology
Cap	3	---	Energy Resilience

Total Hours 33

Figure 2. Energy Resilience – Management Track

5. H.G. Chissell of the Advanced Energy Group offered CGRS a year-long complimentary membership to continue engaging on energy resilience conversations.

6. The conversations resulting from RT1 have also deepened CGRS discussions with local and regional partners including Vermont's Energy Action Network, and various utilities and energy related non-profits that regularly partner with Norwich University.

7. The discussions raised several questions that do not have answers as yet, creating a rich set of research possibilities, that could be undertaken by students enrolled in any of the courses covering the content as an in-class research project, by applying to the Norwich University Undergraduate Research Fellowship, through collaborative research or internship opportunities with one of the partners at the Round Table, including CERL or CRREL, as relevant.

8. The interviews from April 4 provide the following opportunities for the CGRS energy track:

    a. Access to experts with different perspectives on the questions that were raised during the interviews.
    b. Opportunities to engage faculty and students who are not directly researching energy resilience (for example faculty members working on Smart transportation may be interested in connecting their work with the role that energy plays in smart transportation, and the consequences of the inter-connections in these areas for military installation and operation.
    c. Leads on tools, agencies, policies, strategies, manuals of practice, industry standards, etc. that should be considered in curriculum development.
    d. Designing a follow up survey to expand on the one that was administered prior to RT1.
    e. Events, conferences, workshops, that faculty involved in the CGRS energy track development efforts should go to/be aware of, as well as people who could be mentors, advisers, guest and adjunct lecturers.

9. Both the Round Table discussions and the interviews provided a range of options to take the CGRS curriculum development in, from leads on whom to engage on RT2 on public private partnerships, to how to implement the curriculum, once the planning phase is complete. Some of these leads include: running table top exercises, using online platforms for scenario planning, etc.

Draft Roadmap for "Development of an Energy Track within the Norwich University Center for Global Resilience and Security"

The final deliverable of a roadmap for the development of an energy track within the Norwich University Center for Global Resilience and Security (CGRS) will result from literature review, structured conversations with experts across sectors and ongoing discussions with cross-sectoral experts in the areas of energy resilience, with a specific focus on the installation and operation areas.

We envision the following for the CGRS energy track roadmap:

1. Energy resilience is centered in the intersections between technological advancements, mission readiness, and human centered design (Please see figure 1).

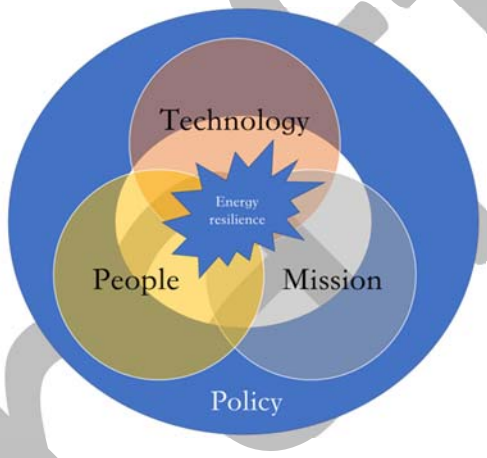

Figure 1. Energy resilience track at CGRS

2. Policy is a core component of each of the three areas that influence energy resilience, driving technological innovations, mission readiness, and human impacts.

3. The roadmap will help us develop a network of experts made up of faculty and researchers, policy makers and industry leaders, who will help us review existing literature to determine state of the art theory and practice related to the area of energy resilience, focusing on installation and operation. This group will also enable the energy track's efforts in:
    a. ***Education:*** Undergraduate, and graduate students, as well as high school students will be engaged through classroom, seminar, and laboratory activities related to installation and operational energy resilience.
    b. ***Research:*** This will entail engaging in original research, collaborating with other educational institutions, federal and state labs and research centers, with a view to publishing findings in peer reviewed literature, white papers, presenting at conferences, and participating in competitions such as the "Hack for Defense"
    c. ***Dissemination:*** Advanced knowledge and research findings will be disseminated through seminars, workshops, and conferences for students and leaders in the military and non-military sectors.

4. The roadmap will be produced through mechanisms noted above:
    a. The three roundtables, on 1) energy fundamentals, 2) public-private partnerships, and 3) financial modeling.
    b. Surveys that will be administered to various stakeholders to inform the pre and post roundtable discussions.
    c. Engagement with related non-military entities that influence energy resilience, and are involved with the installation and operational energy resilience issues from a non-DoD perspective. For example, local utilities, nonprofit organizations, private businesses, industry leaders in the areas, and academic institutions already working on these issues. This includes a review of published reports and literature in this area.
    d. A thorough review of the Norwich University curriculum, focusing on all coursework that covers any aspect of energy resilience.
    e. A working group of Norwich university faculty, and other colleagues (including external partners), who have the potential to influence the curriculum and provide opportunities for students to engage in hands on education in the areas of energy resilience. The working group will also be used to recommend changes to the curriculum, following the findings of the roundtable conversations, and helping CGRS come up with a blueprint of bringing the curricular changes to the university committees responsible for approving these changes.

5. It is expected that the final roadmap will result in:
    a. Curricular enhancements
        i. New academic major/minor(s)
        ii. Certificates
    b. Dissemination of knowledge
        i. Student and faculty research
        ii. Publications in peer-reviewed journals
        iii. White papers
        iv. Online dashboard

CONTRACT TITLE: DEVELOPMENT OF AN ENERGY TRACK WITHIN THE NORWICH UNIVERSITY CENTER FOR GLOBAL RESILIENCE AND SECURITY

Round Table #2 Public-Private Partnerships: Out Report

Contract No. W913E519C0002

Prepared for and Emailed to:

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Executive Summary: Round Table (RT) #2 Public-Private Partnerships (P3) was conducted on June 17-18, 2019 in Washington DC. The intent of this RT was to engage stakeholders and public and private organizations from diverse backgrounds to provide insight and perspectives into the development of the CGRS educational research framework. Specifically, NUARI and team surveyed perspectives to compare and contrast the use of various tools, channels, and models of success in a range of categories (including Policy & Regulations; Culture & Labor; Budgets & Economic Models; Security & Cyber; and Sustainment & Logistics), as well as perspectives on barriers to P# pursuits (including Labor Shortages; Training Standards; Organizational & Structural Change; Policies; and Collaboration Mechanics). Specific feedback from RT#2 is below. NUARI and NU CGRS continue to discover critical input from stakeholders and subject matter experts (SMEs).

Round Table #2: Public-Private Partnerships

Prior to the second Round Table, NUARI and team asked for feedback on metrics of success in order to achieve the most effective outcome for all participants-action officers, as well as senior leaders. To adequately capture discussion and feedback, we employed the use of Sli.do Audience Interaction (https://www.sli.do/).

Included as attachments to this report is the following material, which has been analyzed by NU CGRS (analysis below):

Attachment 1. P3 Discussion Quad. This is the document the team used on both days of the RT2 program to encourage dialog. The primary question posed was: *How can we engage P3 collaborations appropriately within the existing framework of our organization?*

- Trusted collaborators list: a list of organizations of all colors who have committed themselves to collaborating in good faith, and according to agreed-upon precepts, in order for government organizations to know who they can talk to about specific topics, before clearances are required.
- Collaboration mechanics flowchart: a how-to manual of approved P3 collaborations, whether formally P3 or informally collaborating.

Attachment 2. Poll Results. This document includes a list of questions and corresponding answers from participants.

- Q1B: this notable word cloud populated underscored the need for education and a better process to best leverage P3 for rapid innovation.
- Q2: this question asked what students should know about P3 with more than half responding that the how of collaboration, “collaboration mechanics” is the most important thing.
- Q3: areas CGRS students can see P3 in action.
- Q4: tabletop exercise feedback.

- Q16: notable feedback regarding what is necessary for leaders to know about P3 underscored the desire for success and failures to be understood and learned from, rather than replicating failures due to lack of awareness

- Q20: the biggest barrier to collaboration is FEAR; fear of collaborating outside the lines by contracting and legal offices, or by those who want to extend their careers but are afraid to--not incentivized to--risk.

Attachment 3. Confidential Poll Responses. This document includes attributes answers to each question based on a participant number ("user ID"), in a confidential manner.

Attachment 4. P3 Questions by Category. This document breaks out the answers to each question by category.

CGRS Analyses

Overall CGRS analyses notes are included in this section.

During RT2 the use of sli.do and small group conversations added to the conversation on P3. The specific questions, responses, polls, etc. are provided as attachments hereto. Here are the takeaways from the CGRS perspective:

1. The P3 elements that were discussed throughout RT2 may be relevant as a stand-alone piece of the curriculum at the more senior entry points, such as managers and senior leaders, who already have an understanding of the P3 process. At the lower entry levels, especially in the undergraduate curriculum, it may be more relevant to embed P3 concepts in multiple course offerings throughout the four years, so that students can appreciate topics such as risk, organizational structure, process flows, etc. in context. Using examples or case studies related to energy resilience may be the best way to show students the P3 path within the energy resilience sector.

2. All students should have a clear understanding of various terms associated with P3, and the roles of the "public" and "private" as they apply to DoD specifically, because these may be different as compared to P3 contracts pursued in the non-DoD public sector, for example in local municipalities.

3. Risk - assessment, analysis, communication as it related to energy resilience related policy and regulations (including the development of DoD requirements and RFPs), technology development, finance instruments, etc. were unanimously considered relevant to the P3 component of a CGRS curriculum on energy resilience.

4. A comprehensive database of both successes and failures on P3 in the DoD would be helpful to everyone from senior leaders to undergraduates involved in the CGRS energy resilience track. This is critical to a deep understanding of energy resilience and P3.

5. A modular structure for the P3 related CGRS energy track curriculum could feature the following units - to be embedded at different levels depending on entry points into the curriculum (undergraduates to senior military leaders):

a. Legalities and contracts
b. Case studies
c. Leadership
d. Target audience
e. Portfolios

Some additional specific takeaways based on the questions posed during RT2 across the two days include the following:

1. Q1 how organizations can better leverage P3 to enable rapid innovation changed from "ensure", "risk", "leverage" type themes on Day 1 to "education" and "process" on Day 2. This is extremely relevant to the CGRS energy resilience track development, since the curricular component will have to necessarily address the P3 process. The discussion revealed that the process is not uniform across even DoD entities, let alone in various other private organizations and non DoD public sector groups. Therefore, some key tenets of the P3 process should be a part of the energy track curriculum to include the following possibilities as examples of a more comprehensive list that will be developed over time:

a. A comprehensive knowledge of the organizational structure and chain of command.
b. A working knowledge of contracts and negotiations.
c. An awareness of forums such as industry days to generate ideas.
d. Possible funding mechanisms that will play a key role in P3.

2. There was an acknowledgement that this aspect of curriculum development is necessary as both industry and DoD sides need in-house expertise on P3, including a common understanding of terms associated with P3.

3. Some concerns that were expressed during discussions included the following:

a. Industry/companies that were formed by ex DoD folks still find it hard to work with DoD on contracts for P3 and would rather be in the civilian/corporate space.

b. Information and knowledge is intrinsic to the organization even within the DoD. It will be helpful to bring together different DoD areas that are working on the same thing - then set up P3s with industry/labs.

c. How to reduce the DoD P3 timeline to a 12-month period?

4. Barriers to transparency, especially related to legalities, were considered to be true challenges and education and participation in conversations during events like Industry days and having NU/CGRS host Technical Industry Liaison Officer (TILO) for sharing advanced technological advancements were considered to be a way to start addressing these concerns.

5. One industry perspective was that the value proposition had to be clear so any assumptions that P3 is just a way for industry to make money can be addressed, with the understanding that as industry develops leading edge energy resilience technologies, there are inherent risks and responsibilities involved in the product development, that involves time and money resources.

6. There was also some discussion on whether P3 is a soft collaborative activity or a more structured process for a specific strategic alliance/teaming arrangement - which would be relevant questions to have students of an energy resilience track involved in debating.

7. Q2 - The most important thing CGRS students have to know about the P3 approach is:

a. Energy savings performance contracts.

b. Policy and regulation: The discussion focused on the DoD requirements language.

c. Lean manufacturing.

d. Path of least resistance - this discussion suggested that technology is sometimes outdated by the time RFP is out. Industry moves incrementally - product and technology development evolves in six-month increments with adjustments along the way.

ATACHMENT 1: P3 Discussion Quad

Q: How can we appropriately engage P3 collaborations within the existing framework of our organizations?

BARRIERS

Identify barriers to success:

- Policy & Regulation
- Culture & Labor
- Budgets & Economic Models
- Security & Cyber

OPPORTUNITIES

Identify approach for P3 engagement including:

- Mixing "colors" of money (e.g. ERCIP, OECIF, Congressional funding)
- Long-term sustainment models
- Finance mechanisms
- Timing of P3 engagement in the process

P3

TOOLS

The physical instruments: legal agreements / policies / legal agreements

CHANNELS

The route or path: forums / engagements / organizations

MODELS OF SUCCESS

The most effective path for P3 solutions

Trusted collaborators list?
Pathways to success?

NORWICH UNIVERSITY

ATTACHMENT 2 Poll Results

RT2 - Public Private Partnerships

17 - 18 Jun 2019

Poll results

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Table of contents

Wordcloud poll

Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)

0 1 3

Wordcloud poll

Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)

016

Multiple-choice poll (Multiple answers)

Q2 - The most important thing CGRS students have to know about the P3 approach is:

(1/2)

0 1 6

How to get new technologies through the system

19 %

Private Sector budgets and economic models

6 %

Policy and Regulation

19 %

Collaboration Mechanics

56 %

Cultural Awareness within organisations

38 %

Multiple-choice poll (Multiple answers)

Q2 - The most important thing CGRS students have to know about the P3 approach is:

(2/2)

0 1 6

Cyber Security

0 %

Other - please comment

6 %

Open text poll

Q3 - As part of the NUARI training, where could you observe P3 in action?

004

- Miramar Naval Air Station, ACSIM, AUSA, Association of defense communities.
- Army depots have multiple P3 options.
- AUSA Annual Meeting Trade Shows
- Ft Drum or Huntsville Center

Q4 - TableTop Exercise Identifying Tools/Channels/Models for success
(1/3)

0 0 3

- Table 2 Assumptions: Funding is available Build an internal Core Team that covers Issue understanding, procurement process and mechanisms and ethics adherence Identify public partners that will be affected from the ripple of your project - to get input and have buy in Hold an Industry Day focused on solving this problem as well as who is beneficiary of the additional power Industry day helps inform the RFI Process with a goal of getting to an RFP under an OTA Vendors deliver scaled prototypes (Funded) and RFP responses that lead to a Down select to 2-3 vendor prototypes that will be delivered with a specific outcome. Evaluate the prototypes to down select to a single vendor who provides a BAFO. Public review period prior to final contract award.
- Table 3 Barriers: - No money -

Q4 - TableTop Exercise Identifying Tools/Channels/Models for success
(2/3)

003

Limited contracting options for P3 - Lack of internal skilled labor force Tools - Quad Chart - White paper - Other Transactional Authority (OTA) Reason: Little to no cost to present problem, solution, current cost, and value proposition (benefit to solving). Example Solution: - Lockheed Martin has an energy storage unit. -
Could we solicit the development of mobile energy storage solution? - Value proposition must up front clear, financial benefits or P3 and mission benefits Channels - PEO(s) - USACE - Contractors Models of Success - Socialization of the instrument (more collaboration/discussion) Timeframe - Phased approach TBD, final instrument presented w/in 1 year

- Table 1: Assumption = energy manager = action

Q4 - TableTop Exercise Identifying Tools/Channels/Models for success
(3/3)

003

officer level Goal: Wants a way to capture unused energy Recommendation: They have to tie their goal to the mission set goal on the installation (for the unit that is assigned to the base). Mission of tenant/installation. Example: Communication: They have to talk to person in charge of enabling that function; for ex for communications - talk to S6/Information manager (IMO) of the base i.e. Energy manager

talks to IMO who then together as a team, take the idea to Garrison commander. Then further sell to Lt/Senior Commander/Commanding Gen = creating coalition for change. Key to selling = value proposition = improve mission + little to no cost Use: IMCOM and ACSIM's partnership offices to set up the P3 - outline available tools (for ex. in kind contributions). Partners defend the technology solution.

Multiple-choice poll

Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?

0 1 3

Yes

69 %

No

31 %

Open text poll

Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?

009

- Formal process of presenting officials with a new technology, similar to what Kevin M discussed. Information gathering ->> requirements gathering --> public FOA
- Education partnership agreements
- IDIQ's MATOC
- As a startup innovator, have only engaged through one-off contacts, briefings and mil service demonstration events.
- MOU, MOA, NDA
- In the energy sector, Utiliy Energy Savings Contracts
- Ideation, workshops, symposia, telephones, IGSAs, vendor demonstration agreements.
- Labs Diu Inqtel
- Memorandum of Agreements and Non-disclosure agreements.

Open text poll

Q16 - What do you think is important for leaders to know about public/private partnerships?

014

(1/2)

- What partnerships have been successful/failed in the past and how those lessons learned allow for a greater likelihood of success for future partnerships.
- There are tools and expertise within their own organization that leaders can leverage, but there are also internal barriers that leaders need to be able to exercise their authority to remove them.
- You need a knowledgeable guide to set you on a successful path.
- Education first and foremost. Then collaboration and an understanding that industry in general are not a bunch of “stodgy money grubbing defense contractors.”
- Tools/Channels to overcome barriers. Past successes and failures.
- Their own organization may resist change for many reasons. Policy and money

Open text poll

Q16 - What do you think is important for leaders to know about public/private partnerships?

(2/2)

014

and authority must me aligned and connected. Results must be tracked.

- P3 can be official, or unofficial. P3 often happens before there is a formalized process for engagement and collaboration. They need to know HOW to engage and collaborate before "official" P3 status (legal, contracting, etc).
- Tech development and commercially ready solutions are different pathways
- How financing mechanisms can operate to implement P3 projects.
- Integration between different agencies.
- How they work.
- Where to start, to find P3 information.
- Paths Available
- They work

Multiple-choice poll

Q18 - Which do YOU believe?

0 1 5

An Un-Official P3 is required before a formalized process for engagement

73 %

An Official P3 needs to be in place before there is a formalized process for engagement

27 %

Open text poll

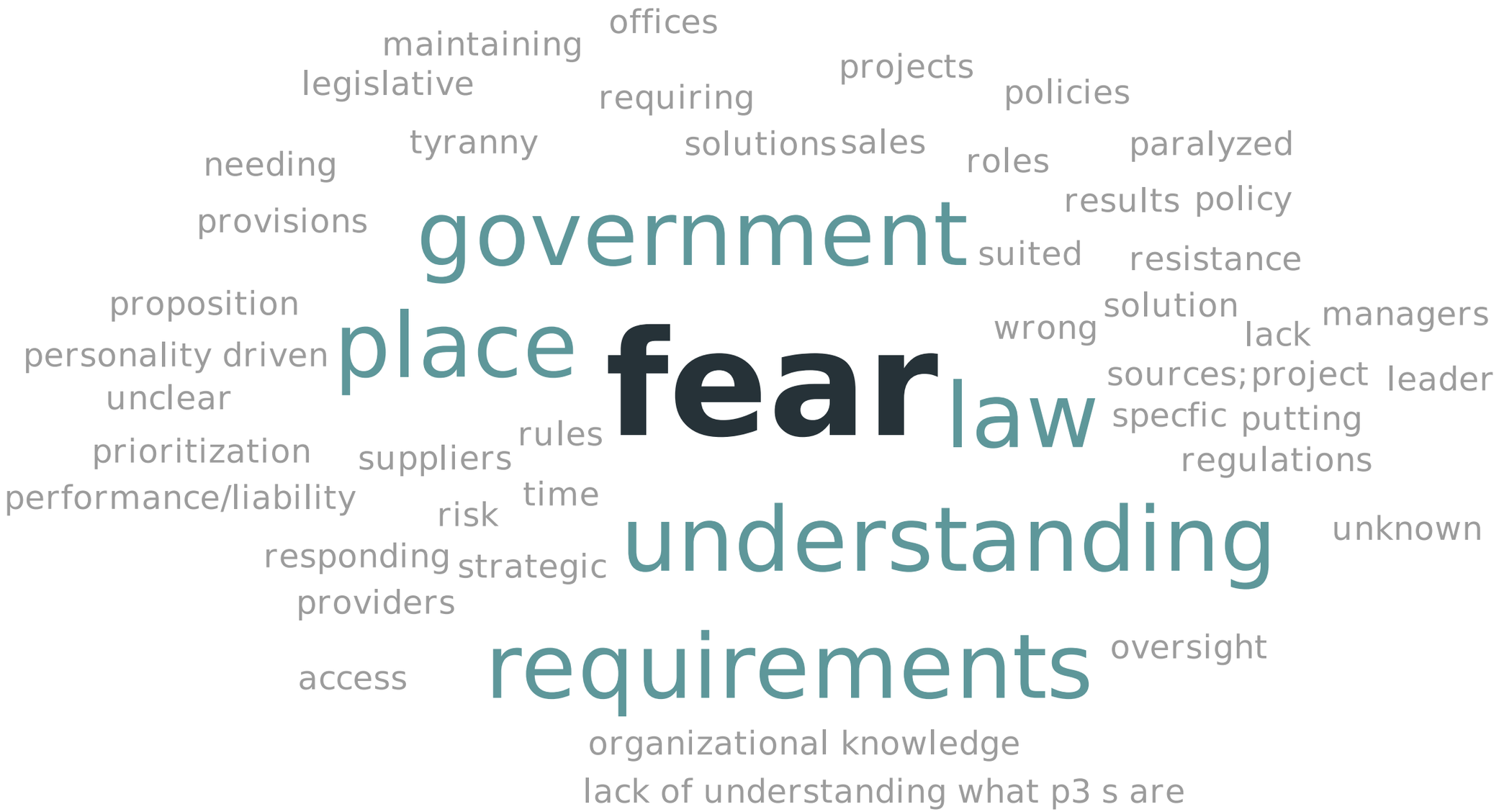
Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?

005

- Advanced planning brief to industry. (APBI)
- AUSA
- Army REF and MARCORSYSCOM early testing and field data collection of innovative operational energy systems circa 2010-12.
- Task Forces
- Industry Day's

Q20 - List the barriers to appropriately engage P3 Collaborations.

0 1 5



Attachment 3 Confidential Poll Responses

User ID	Poll ID	Poll Type	Poll Question	Poll Option
44554299	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Enable ready contact from private sector solution providers - with govt people to vet and give time to legitimate solution providers, make it easy for govt experts to hear what they are offering, and have overwatch by ethics/legal people to ensure against improper dealings.
44554299	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Create a legal process for rapid and open engagement with guidance and ethical oversight. It should not disadvantage vendors because it will include even more inputs from stakeholders and the public. But to participate, parties will have to pay attention and act fast.
44554299	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Create a legal process for rapid and open engagement with guidance and ethical oversight. It should not disadvantage vendors because it will include even more inputs from stakeholders and the public. But to participate, parties will have to pay attention and act fast.
44554299	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Policy and Regulation
44554299	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	No
44554299	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	As a startup innovator, have only engaged through one-off contacts, briefings and mil service demonstration events.
44554299	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Their own organization may resist change for many reasons. Policy and money and authority must me aligned and connected. Results must be tracked.
44554299	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Official P3 needs to be in place before there is a formalized process for engagement
44554299	2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Army REF and MARCORSYSCOM early testing and field data collection of innovative operational energy systems circa 2010-12.
44554299	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Government side not knowing how to access solutions most suited to requirements. Solution providers not certain it is worth the effort and expense of responding. Managers needing to know they are within law and policy.
44558433	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Be more flexible on allowing private partners to retain IP rights developed in the partnership.
44558433	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	A strong understanding of the different government contracting options will allow for the most effective choices.
44558433	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Policy and Regulation
44558433	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
44558433	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	No
44558433	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	You need a knowledgeable guide to set you on a successful path.
44558433	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement

44558433	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Paralyzed by the rules requiring absolute fairness
44558533	2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	Ft Drum or Huntsville Center
44558533	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	No
44558799	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Organizations should train and maintain a dedicated staff to identify and manage public/private partnership opportunities.
44558799	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Collaboration and learning (open minds)
44558799	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
44558799	2814482	Open Text	Q4 - TableTop Exercise Identifying Tools/Channels/Models for success	Table 3 Barriers: - No money - Limited contracting options for P3 - Lack of internal skilled labor force Tools - Quad Chart - White paper - Other Transactional Authority (OTA) Reason: Little to no cost to present problem, solution, current cost, and value proposition (benefit to solving). Example Solution: - Lockheed Martin has an energy storage unit. - Could we solicit the development of mobile energy storage solution? - Value proposition must up front clear, financial benefits or P3 and mission benefits Channels - PEO(s) - USACE - Contractors Models of Success - Socialization of the instrument (more collaboration/discussion) Timeframe - Phased approach TBD, final instrument presented w/in 1 year
44558799	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44558799	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Where to start, to find P3 information.

44558799	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44558799	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Fear
44560217	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Ensure that the technical SME are not required to become P3 experts for P3 to be viable.
44560217	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	How to get new technologies through the system
44560217	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
44560217	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
44560249	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Technology development plan competitions, such as ARPA-E
44560249	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Technology development competitions, such as ARPA-E
44560249	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	How to get new technologies through the system
44560249	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	No
44560249	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Integration between different agencies.
44560249	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Official P3 needs to be in place before there is a formalized process for engagement
44560249	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Organizational knowledge
44561228	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	resource
44561228	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Policy and Regulation
44561228	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
44561228	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
44561228	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Official P3 needs to be in place before there is a formalized process for engagement

44561498	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Education. Process. Communication.
44561498	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Education. Process. Communication.
44561498	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
44561498	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
44561498	2814482	Open Text	Q4 - TableTop Exercise Identifying Tools/Channels/Models for success	Table 1: Assumption = energy manager = action officer level Goal: Wants a way to capture unused energy Recommendation: They have to tie their goal to the mission set goal on the installation (for the unit that is assigned to the base). Mission of tenant/installation. Example: Communication: They have to talk to person in charge of enabling that function; for ex for communications - talk to S6/Information manager (IMO) of the base i.e. Energy manager talks to IMO who then together as a team, take the idea to Garrison commander. Then further sell to Lt/Senior Commander/Commanding Gen = creating coalition for change. Key to selling = value proposition = improve mission + little to no cost Use: IMCOM and ACSIM's partnership offices to set up the P3 - outline available tools (for ex. in kind contributions). Partners defend the technology solution.
44561498	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44561498	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Tools/Channels to overcome barriers. Past successes and failures.
44561498	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44561737	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Explore opportunities of in-kind contributions to pilot technologies and capabilities with benefits to all parties with minimal financial risk.
44561737	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Use in-kind investments to lower individual risk and maximize benefits to mission across the partnership, with lower risk to cost.
44561737	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics

44561737	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Other - please comment
44561737	2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	Miramar Naval Air Station, ACSIM, AUSA, Association of defense communities.
44561737	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44561737	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Ideation, workshops, symposia, telephones, IGSAs, vendor demonstration agreements.
44561737	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	There are tools and expertise within their own organization that leaders can leverage, but there are also internal barriers that leaders need to be able to exercise their authority to remove them.
44561737	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44561737	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	International. Legislative, tyranny of the immediate, risk aversion, unclear roles, lack of understanding, creating, maintaining. Implementation, lack of oversight. Lack of flexibility, cultural differences, resistance to change, willingness, place-specfic issues.
44561846	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	P3 enables rapid innovation by bringing many types of financing (Federal and local governments, local communities, and entrepreneurs) to fund specific community or government projects.
44561846	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Leverage
44561846	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
44561846	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Memorandum of Agreements and Non-disclosure agreements.
44561846	2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	AUSA
44561846	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Lack of understanding what P3's are.
44562069	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Funding
44562069	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Catalytic research funding
44562069	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Private Sector budgets and economic models
44562278	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Understanding of P3s are growing, yet there remains a large information gap. Closing the gap would greatly improve the ability to leverage P3. Leaders remain cautious of things they don’t understand.
44562278	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics

44562278	2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	Army depots have multiple P3 options.
44562278	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44562278	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	MOU, MOA, NDA
44562278	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Education first and foremost. Then collaboration and an understanding that industry in general are not a bunch of “stodgy money grubbing defense contractors.”
44562278	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44562278	2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Advanced planning brief to industry. (APBI)
44562278	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Government leader knowledge, law, understanding of the value proposition, fear of doing something wrong...
44562328	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Joint Goal and Risk Sharing
44562328	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
44562328	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44562373	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
44562382	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Educate, Facilitate and Motivate
44562382	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
44562386	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Training and Education
44562386	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	How to get new technologies through the system
44562407	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Complete transparency
44562407	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Think outside the box
44562407	2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Open minded

44562407	2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
44562407	2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	AUSA Annual Meeting Trade Shows
44562407	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44566244	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Understand DOD Challenges
44566244	2814482	Open Text	Q4 - TableTop Exercise Identifying Tools/Channels/Models for success	Table 2 Assumptions: Funding is available Build an internal Core Team that covers Issue understanding, procurement process and mechanisms and ethics adherence Identify public partners that will be affected from the ripple of your project - to get input and have buy in Hold an Industry Day focused on solving this problem as well as who is beneficiary of the additional power Industry day helps inform the RFI Process with a goal of getting to an RFP under an OTA Vendors deliver scaled prototypes (Funded) and RFP responses that lead to a Down select to 2-3 vendor prototypes that will be delivered with a specific outcome. Evaluate the prototypes to down select to a single vendor who provides a BAFO. Public review period prior to final contract award.
44566244	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Paths Available
44566244	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Official P3 needs to be in place before there is a formalized process for engagement
44566244	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Fear
44569446	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Information dissemination
44569446	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44569446	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44569446	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Complexity of regulations and policies
44571187	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes

44571195	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Education
44571195	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Collaboration
44571195	2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
44571195	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	How they work.
44655678	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Education
44655678	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	authorities
44655678	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	case studies
44655678	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	IDIQ's MATOC
44655678	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	They work
44655678	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44655678	2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Industry Day's
44655678	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Congress OMB
44656127	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Tech exposure opportunities through P3 forums
44656127	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Labs Diu Inqtel
44656127	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Tech development and commercially ready solutions are different pathways
44656127	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44656127	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Matching requirements and suppliers Time Prioritization Results
44657689	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	agile

44657689	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	What partnerships have been successful/failed in the past and how those lessons learned allow for a greater likelihood of success for future partnerships.
44657689	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Unknown benefit for industry collaborators. What will this do for my business from a future sales basis?
44658471	2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Collaboration between Military bases and their adjacent communities is key
44658471	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	In the energy sector, Utiliy Energy Savings Contracts
44658471	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	How financing mechanisms can operate to implement P3 projects.
44658471	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44658471	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Identifying adequate financing sources; putting in place comprehensive project performance/liability provisions.
44661482	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Education partnership agreements
44661482	2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	P3 can be official, or unofficial. P3 often happens before there is a formalized process for engagement and collaboration. They need to know HOW to engage and collaborate before "official" P3 status (legal, contracting, etc).
44661482	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44661482	2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Task Forces
44661482	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Personality-driven
44667379	2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Formal process of presenting officials with a new technology, similar to what Kevin M discussed. Information gathering ->> requirements gathering --> public FOA
44667379	2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement
44667379	2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Difficult to identity the decision maker(s) and those offices willing and able to take action on ideas / projects, even those of interest and aligned with strategic needs

Attachment 4 P3 Questions by Category

Poll ID	Poll Type	Poll Question	Poll Option
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Open minded
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Understanding of P3s are growing, yet there remains a large information gap. Closing the gap would greatly improve the ability to leverage P3. Leaders remain cautious of things they don't understand.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Enable ready contact from private sector solution providers - with govt people to vet and give time to legitimate solution providers, make it easy for govt experts to hear what they are offering, and have overwatch by ethics/legal people to ensure against improper dealings.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Think outside the box
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Ensure that the technical SME are not required to become P3 experts for P3 to be viable.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Leverage
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	P3 enables rapid innovation by bringing many types of financing (Federal and local governments, local communities, and entrepreneurs) to fund specific community or government projects.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Explore opportunities of in-kind contributions to pilot technologies and capabilities with benefits to all parties with minimal financial risk.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Be more flexible on allowing private partners to retain IP rights developed in the partnership.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Technology development plan competitions, such as ARPA-E
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Complete transparency
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Education. Process. Communication.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Organizations should train and maintain a dedicated staff to identify and manage public/private partnership opportunities.
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Educate, Facilitate and Motivate
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Joint Goal and Risk Sharing
2813358	Open Text	Q1 - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Funding
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	A strong understanding of the different government contracting options will allow for the most effective choices.
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Collaboration between Military bases and their adjacent communities is key
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Use in-kind investments to lower individual risk and maximize benefits to mission across the partnership, with lower risk to cost.
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	agile
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Catalytic research funding
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Create a legal process for rapid and open engagement with guidance and ethical oversight. It should not disadvantage vendors because it will include even more inputs from stakeholders and the public. But to participate, parties will have to pay attention and act fast.

2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Tech exposure opportunities through P3 forums
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Technology development competitions, such as ARPA-E
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Understand DOD Challenges
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Information dissemination
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	case studies
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	resource
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Collaboration and learning (open minds)
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Collaboration
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	authorities
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Training and Education
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Education. Process. Communication.
2819931	Open Text	Q1B - How can organizations better leverage Public/Private partnerships (P3) to enable rapid innovation? Short answer please (30 characters or less)	Education
2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	How to get new technologies through the system
2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Private Sector budgets and economic models
2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Policy and Regulation
2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Cyber Security
2813378	Multiple choice (Multiple answer)	Q2 - The most important thing CGRS students have to know about the P3 approach is:	Other - please comment

2819978	Multiple choice (Multiple answer)	Q2B- The most important thing CGRS students have to know about the P3 approach is:	How to get new technologies through the system
2819978	Multiple choice (Multiple answer)	Q2B- The most important thing CGRS students have to know about the P3 approach is:	Private Sector budgets and economic models
2819978	Multiple choice (Multiple answer)	Q2B- The most important thing CGRS students have to know about the P3 approach is:	Policy and Regulation
2819978	Multiple choice (Multiple answer)	Q2B- The most important thing CGRS students have to know about the P3 approach is:	Collaboration Mechanics
2819978	Multiple choice (Multiple answer)	Q2B- The most important thing CGRS students have to know about the P3 approach is:	Cultural Awareness within organisations
2819978	Multiple choice (Multiple answer)	Q2B- The most important thing CGRS students have to know about the P3 approach is:	Cyber Security
2819978	Multiple choice (Multiple answer)	Q2B- The most important thing CGRS students have to know about the P3 approach is:	Other - please comment
2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	Miramar Naval Air Station, ACSIM, AUSA, Association of defense communities.
2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	Army depots have multiple P3 options.
2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	AUSA Annual Meeting Trade Shows
2814458	Open Text	Q3 - As part of the NUARI training, where could you observe P3 in action?	Ft Drum or Huntsville Center
2819981	Open Text	Q3B - As part of the NUARI training, where could you observe P3 in action?	

2814482	Open Text	Q4 - TableTop Exercise Identifying Tools/Channels/Models for success	Table 2 Assumptions: Funding is available Build an internal Core Team that covers Issue understanding, procurement process and mechanisms and ethics adherence Identify public partners that will be affected from the ripple of your project - to get input and have buy in Hold an Industry Day focused on solving this problem as well as who is beneficiary of the additional power Industry day helps inform the RFI Process with a goal of getting to an RFP under an OTA Vendors deliver scaled prototypes (Funded) and RFP responses that lead to a Down select to 2-3 vendor prototypes that will be delivered with a specific outcome. Evaluate the prototypes to down select to a single vendor who provides a BAFO. Public review period prior to final contract award.
2814482	Open Text	Q4 - TableTop Exercise Identifying Tools/Channels/Models for success	Table 3 Barriers: - No money - Limited contracting options for P3 - Lack of internal skilled labor force Tools - Quad Chart - White paper - Other Transactional Authority (OTA) Reason: Little to no cost to present problem, solution, current cost, and value proposition (benefit to solving). Example Solution: - Lockheed Martin has an energy storage unit. - Could we solicit the development of mobile energy storage solution? - Value proposition must up front clear, financial benefits or P3 and mission benefits Channels - PEO(s) - USACE - Contractors Models of Success - Socialization of the instrument (more collaboration/discussion) Timeframe - Phased approach TBD, final instrument presented w/in 1 year

2814482	Open Text	Q4 - TableTop Exercise Identifying Tools/Channels/Models for success	Table 1: Assumption = energy manager = action officer level Goal: Wants a way to capture unused energy Recommendation: They have to tie their goal to the mission set goal on the installation (for the unit that is assigned to the base). Mission of tenant/installation. Example: Communication: They have to talk to person in charge of enabling that function; for ex for communications - talk to S6/Information manager (IMO) of the base i.e. Energy manager talks to IMO who then together as a team, take the idea to Garrison commander. Then further sell to Lt/Senior Commander/Commanding Gen = creating coalition for change. Key to selling = value proposition = improve mission + little to no cost Use: IMCOM and ACSIM's partnership offices to set up the P3 - outline available tools (for ex. in kind contributions). Partners defend the technology solution.
2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
2814462	Multiple choice (Single answer)	Q5 - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	No
2819990	Multiple choice (Single answer)	Q5B - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	Yes
2819990	Multiple choice (Single answer)	Q5B - Are Public/Private Partnerships a lever/mechanism to accelerate innovation?	No
2819564	Open Text	Q6 - Who pays for the Army Corps (USACE) to down-select the art of the possible?	
2819574	Open Text	Q7 - Who has the authority to give action officers the right of way?	
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Formal process of presenting officials with a new technology, similar to what Kevin M discussed. Information gathering ->> requirements gathering --> public FOA
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Education partnership agreements
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	IDIQ's MATOC
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	As a startup innovator, have only engaged through one-off contacts, briefings and mil service demonstration events.
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	MOU, MOA, NDA
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	In the energy sector, Utiliy Energy Savings Contracts
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Ideation, workshops, symposia, telephones, IGSAs, vendor demonstration agreements.

2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Labs Diu Inqtel
2819576	Open Text	Q8 - What tools have you used or could be used to engage P3 Collaborations within the existing framework of our organizations?	Memorandum of Agreements and Non-disclosure agreements.
2819577	Open Text	Q9 - Who authorizes OTA use, or other tools, the legal authority and the contracting authority?	
2819595	Open Text	Q10 - If P3 doesn't shorten timelines, enhance innovation or extend national security, why use them?	
2819605	Open Text	Q11 - How do we know what contracting command will approve?	
2819608	Multiple choice (Single answer)	Q12 - Do we involve the utility?	Yes
2819608	Multiple choice (Single answer)	Q12 - Do we involve the utility?	No
2819613	Open Text	Q13 - How does a senior executive see the process, enable the action level, in a replicable way?	
2819615	Open Text	Q14 - What are the creative finance tools we should be considering?	
2819619	Open Text	Q15 - Who funds the coalition building that is needed to execute on P3 successes?	
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	What partnerships have been successful/failed in the past and how those lessons learned allow for a greater likelihood of success for future partnerships.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	There are tools and expertise within their own organization that leaders can leverage, but there are also internal barriers that leaders need to be able to exercise their authority to remove them.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	You need a knowledgeable guide to set you on a successful path.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Education first and foremost. Then collaboration and an understanding that industry in general are not a bunch of "stodgy money grubbing defense contractors."
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Tools/Channels to overcome barriers. Past successes and failures.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Their own organization may resist change for many reasons. Policy and money and authority must me aligned and connected. Results must be tracked.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	P3 can be official, or unofficial. P3 often happens before there is a formalized process for engagement and collaboration. They need to know HOW to engage and collaborate before "official" P3 status (legal, contracting, etc).
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Tech development and commercially ready solutions are different pathways
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	How financing mechanisms can operate to implement P3 projects.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Integration between different agencies.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	How they work.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Where to start, to find P3 information.
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	Paths Available
2820265	Open Text	Q16 - What do you think is important for leaders to know about public/private partnerships?	They work
2820299	Open Text	Q17 - What are the barriers to P3 Collaborations?	
2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Un-Official P3 is required before a formalized process for engagement

2820680	Multiple choice (Single answer)	Q18 - Which do YOU believe?	An Official P3 needs to be in place before there is a formalized process for engagement
2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Advanced planning brief to industry. (APBI)
2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	AUSA
2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Army REF and MARCORSYSCOM early testing and field data collection of innovative operational energy systems circa 2010-12.
2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Task Forces
2820722	Open Text	Q19 -Is there a DoD approach you have seen successfully engaging directly and educating the industry on engagement?	Industry Day's
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	International. Legislative, tyranny of the immediate, risk aversion, unclear roles, lack of understanding, creating, maintaining. Implementation, lack of oversight. Lack of flexibility, cultural differences, resistance to change, willingness, place-specfic issues.
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Unknown benefit for industry collaborators. What will this do for my business from a future sales basis?
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Identifying adequate financing sources; putting in place comprehensive project performance/liability provisions.
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Personality-driven
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Paralyzed by the rules requiring absolute fairness
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Complexity of regulations and policies
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Government side not knowing how to access solutions most suited to requirements. Solution providers not certain it is worth the effort and expense of responding. Managers needing to know they are within law and policy.
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Government leader knowledge, law, understanding of the value proposition, fear of doing something wrong...
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Difficult to identity the decision maker(s) and those offices willing and able to take action on ideas / projects, even those of interest and aligned with strategic needs
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Matching requirements and suppliers Time Prioritization Results
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Organizational knowledge
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Lack of understanding what P3's are.
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Congress OMB
2820787	Open Text	Q20 - List the barriers to appropriately engage P3 Collaborations.	Fear

CONTRACT TITLE: DEVELOPMENT OF AN ENERGY TRACK WITHIN THE NORWICH UNIVERSITY CENTER FOR GLOBAL RESILIENCE AND SECURITY

Round Table #3 Funding Mechanisms and Cyber Security: Out Report

Contract No. W913E519C0002

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Introduction

Round Table #3 (RT3) Funding Mechanisms and Cyber Security was conducted on September 23-24, 2019 in Washington DC. The intent of this RT was to explore perspectives and approaches of policymakers and senior leadership related to funding mechanisms on the first day, and the intersections of physical-cyber security related to energy resilience on the second day. The objectives laid out for RT3 were:

1. To identify and assess funding mechanisms and financing that can support operational and installation energy resilience as well as how we might incorporate the resulting outputs from the facilitated discussion into curriculum and training programs while also considering the unique mission requirements, reliability, security, adaptability and risk thresholds;
2. To determine the impact of policies and directives in prioritizing and performing resilience actions so as to be fiscally responsible, while protecting the homeland; and
3. To explore the cyber-physical threats and vulnerabilities that challenge operational and installation energy resilience.

Each objective was met. RT3 outcomes that are summarized below validated the need for including the energy-cyber nexus in the Energy Track. There was an acknowledgement that cyber and energy are both cross-cutting requirements for everything DoD does and having these conversations side by side over the two days was useful.

This report begins with some of the key takeaways from RT3. It then provides some of the specific points and is based on the extensive notes taken during both days of the roundtable by multiple members of the team.

Key Takeaways/Outcomes from RT3

1. Participants on both days of RT3 asked "Who else is doing this?" They meant the holistic development of a curriculum around energy resilience that can address topics ranging from energy fundamentals and the technical know-how of renewable technology and microgrid operation, to all the critical non-technical aspects of operational and installation energy resilience such as leadership, mindsets among various levels of leadership, timelines, collaboration, partnerships (public-private, and public-public), role of industry versus government, funding, risk, vulnerability, and threat assessment, physical and cyber security, etc. It was clear that the NU curriculum emerging from this contract and the final roadmap that will help us develop the curriculum in the future, will be unique in its attempt to draw from an interdisciplinary knowledge base across the military and civilian sectors. The RT3 discussions validated the need for and sequence of the roundtables as developed and conducted, with each conversation emphasizing the demand for a strong energy resilience curriculum, as well as setting out path markers on how to develop a robust multi-tiered approach to education and training in this critical area.
2. Participants also validated the need for a university (in this case NU) to serve as the neutral party in developing and disseminating this form of education and training, and by being a space to bring together government and industry to foster conversations that allow

for creating a feedback loop on the work that is underway and the curriculum that will be produced in future phases of this project.

3. RT3 used multiple pedagogical tools to engage participants in the discussions on funding mechanisms and cyber security considerations in energy resilience in both an installation and operational setting. These pedagogical tools and some key insights developed in each are described below.

A. Case Studies

1) The case studies based on real life installation energy-related projects were an engaging way to deepen the energy resilience discussion and provided specifics that can be embedded into multi-tiered curricula in various helpful ways. Specifically, the case studies allowed for discussions on decision-making hierarchies on base and in the field, risks associated with lack of education (for example, falling prey to phishing attacks in Colorado as explained by LTC Rhodes), benefits of a strong public-public partnership (Fred Meurer's presentation), liability around the duration of contracts such as the Energy Performance Savings Contracts (ESPCs) in volatile markets (Fort Drum presentation by Hon. Katherine Hammack), etc.

2) The case studies underscored the benefit of the system's approach to energy resilience and the associated need for interdisciplinarity in the Energy Track curriculum. They also supported the importance of exposure to issues in energy resilience for all majors, even if we start from their disciplinary lenses.

3) The case studies also revealed how one challenge faced by the right energy manager, or garrison commander, could become a catalyst for multiple forms of energy resilience (and by extension, water, food, and other forms of overall resilience) and help create processes for managing previously unknown challenges.

B. Discussions

1) Hon. Katherine Hammack shared multiple funding mechanisms that DoD can/have/are using to address energy resilience, including Privatization of Army Lodging, Utilities Privatization, ESPCs, ESTCP, SERDP, etc. Her message that PPPs in the Army helped create faster fixes, of better quality, with low risk, and increased renewable energy and clean water resonated throughout the discussions. Very specific questions were raised on the value and ability to measure resilience in the context of risk and liability. (Please see following paragraph C on questions).

2) The discussions on the innovative funding mechanisms and the creative solutions that were being implemented as seen in the various case studies led to several important questions: Where did the innovation originate? Were these one-time solutions or sustainable over a longer duration? The sustainability

was especially considered critical as leadership changes and brings with it the risk of losing institutional or personal knowledge behind an innovative mechanism, process, or solution.

3) Fred Meurer's presentation on Public-Public Partnerships and Installation Risk Analysis led to an extensive and engaging discussion on some of the factors that enabled the success of the Presidio of Monterey. Discussion areas included location proximity, leadership capabilities and vision, communities interested in embedding the installation energy resilience as part of their community economic development model, the role of Smart Cities in looking at the regional maps and collaborating with defense bases, the possibility of energy managers getting trained in municipalities that are making strong energy resilience changes based on sound strategic planning, the role of the National Guard, the differences in training across different installations, how these differences impact mission readiness, and partnerships that haven't even been identified or developed as yet, because of the changing nature of this field.

4) In the case study on the Detroit Arsenal presented by Ms. Shannon Bergt, some key discussion items led to insights on how losing a substation during ice storms (or otherwise) doesn't just challenge energy resilience from an energy availability, access, and use perspective, but also impedes DoD's ability to be mission ready. It also highlighted the fact that as infrastructure across our military bases is aging, a robust R&D program that can strengthen what feeds into base and energy master plans, and trains the managers on technical aspects, creates the processes to help senior leaders make the right decision to "do it right the first time" as infrastructure improvements become necessary. In this context, there was an acknowledgement that we do not have personnel trained and ready to run a microgrid. Collaborating with military labs and universities, partnering with the local utilities and National Guard units were all discussed as ways to build resilient systems.

5) The briefing provided by Dominic Frinzi on Schofield Barracks and the use of Direct Private Investments as a way to leverage land to promote and pay for energy resilience closed out the discussions on RT3 Day 1. This was an abbreviated discussion due to lack of time, making it clear that this is a true gap in our existing frameworks - the ability for experts across sectors to sit at a table and share their expertise in a way that can help a common neutral entity (in this case NU) listen to multiple perspectives, and help build a roadmap to a curriculum that is necessary for all. This is expanded below in the first bullet of paragraph D, "Presentations."

C. Questions

Two questions were posed to the participants at the end of the discussions on Day 1 of RT3. These were:

1) How do you fund the development of resilient systems prior to a crisis event?
2) How should we measure and value resilience?

The responses are provided in the notes section.

D. Presentations

1) Each day of RT3 began with an overview of Norwich University, NUARI, and CGRS, the Energy Track and the accomplishments of RT1 and RT2. Unexpectedly, this introductory presentation resulted in robust conversations, and excellent questions including whether the team had looked at the Department of Energy policies and how their policies intersect with the military. Another big question noted previously was "Who else is doing this?" There was also a strong consensus on the value of these roundtables as a way for multiple cross-sectoral SMEs to "deposit their knowledge." It was noted that the opportunity to create a framework so it thrives – in a neutral environment – outside of priorities of the moment (because DoD resources are often focused on matters of current and therefore changing imperatives), is critical and that NU can be the entity to play this important role of the neutral third party. Offering a space and platform for information exchange, providing the pathway for research and development in collaboration with our military labs, were all briefly discussed in the NU context.
2) Using the example of an Executive Order that was just issued, questions such as "Who are people responsible for protecting industrial control systems (ICS)?" "What are they being trained in?" were raised, even as it was acknowledged that ICS covers lighting control, fire suppression, alarms, PLC, controls, chips, etc., and without the right educational background or awareness training, being responsible for these is an uphill battle for energy managers. Some changes that were recommended were brief guides with persuasive reasons to help leaders with mindsets of "we have always done it this way" embrace the innovations, need for training that breaks silos - in ways that crosses DoD lines, the relevance of correct messaging, etc.
3) There was a general acknowledgement that to maintain a sustained workforce, DoD will have to work harder at protecting its assets (its people), as brain drain is a real risk. Some of the options to extend knowledge base were discussed. These included:
    - Courses at entry level/undergraduate curriculum, which is the easiest task to accomplish;
    - Mid-career – short courses, possibly some online work and seminars at beginning and end to help those with a full-time job and discuss what keeps you awake at night;

- Senior experts: seminars or roundtables – where the "findings" of the courses and exercises completed by mid-career specialists could be discussed with the decision makers;
- Each tier should include an evaluation of interdisciplinary solutions to take advantage of the extensive solution sets that are already completed or underway in the private sector, and academic labs.

4) While Day 1 of RT3 on energy funding mechanisms featured multiple case studies, Day 2 on cybersecurity considerations included presentations that embedded case studies within the presentation, as a way to share examples. The presentation by Col. Scott Nelson provided an overview of the cyber-energy nexus from the Cyber Command perspective. His reminders summarized in the bullets in his presentation resulted in conversations on:
   - How networking everything for convenience poses a big vulnerability and the role played Nation state/Advanced Performance Threats (APTs)
   - The need for a diverse, interdisciplinary talent/workforce that recognizes risk, design, business, biology, political science, etc.
   - Industrial Control System (ICS)/SCADA and IoT
   - Supply-chain related threats as private infrastructure and PPP increase.
   - Information sharing.
   - Whole of nation problem – the need to share information across the board. For example, vulnerabilities in and threats faced by companies like Google are a threat to the government, and vice versa.
5) The Imperatives Col Nelson shared emphasized that building the right defense capacity and capability is hard, but will be easier to sustain once it is built right. He noted that preventing the theft of intellectual property and research from universities will be critical in maintaining US technological advantage. Finally, he also recommended that information sharing through networks (sensors and people) in trustworthy ways so that the flow is bi-directional from the installation to Cyber Command and back to the communities will be important. His analogy of how CDC handles pandemics was well received.
6) The presentation by LTC Rhodes, “The Implications of the Internet of Things (IoT) for Cyber Conflict,” modeled both the use of compelling content in a persuasive information brief style pedagogy, just as well as it demonstrated the need to secure our energy systems against cyber crime and warfare. LTC Rhodes also noted that smart cities are extremely vulnerable, that as big cities are developing strong cyber defenses, bad actors had moved on to smaller cities and municipalities, and are exploring vulnerabilities brought about by commonality of systems, through similar processes, common vendors, etc. Further, we must revisit the convenience-security tradeoff that proliferation of

smart technologies brings into focus. An important discussion that emerged in this presentation was with the problem with cyber security niches; i.e. when some people are technical experts, others are policy experts, etc., and not everyone may have an idea of the other pieces enough to connect the dots. The lack of a degree or continuing education program that can help DoD employees develop cross-connected expertise was noted (most are accidental experts - not intentional). LTC Rhodes recommended that every state and territory should have a defensive cyber operations tactical unit.

7) The closing presentation by NUARI President, Phil Susmann, not only helped bring the day's conversations to a close, but also helped connect with the big picture behind this work. By sharing all the ways that NU, through NUARI, had helped institutions become cyber secure and more resilient in the financial and energy sectors, the presentation underscored NU's commitment to build the Energy Track curriculum using an experiential model that would emphasize interdisciplinarity and offer pathways at multiple levels for a sound educational experience.

Overall, the need for a deeper conversation on cyber concerns and how cyber intersects with energy resilience was heard on Day 1 and by adapting the RT3 programming to include a day on Cyber, we were able to include that discussion, which highlighted additional gaps that NU curriculum will be able to close in future years. Several discussions transcended the energy curriculum conversation and involved creating organizational systems and training platforms that will be a model for interdisciplinary collaboration within NU and across multiple external institutions. There was a charge on how a strong curricular framework can help create intentional cross-sectoral experts - i.e., create a specialization that people may self-tag, but do it in a way that does not impede their promotion.

NOTES

Day One Summary

On Day One, CGRS put on a Round Table focused on energy finance and funding mechanisms, using case studies from several sites to highlight some ways energy resilient infrastructure can be funded or financed. CGRS gained a lot of perspective on the often inconsistency from changes in leadership, to inconsistency in incentives and requirements to policies and guidance. It should be noted that the lack of education or understanding of tools available at all levels of influence are often underscored by the lack of budget to a) study the problem, b) to outline a plan to address the problem, and c) to execute energy resilience projects within that plan.

Privatization can be a vehicle to incorporate some resiliency features using renewables. Due to the current legal and contracting environment, special authorities may be needed to use different methods to finance rather than spending money up front--specifically because OMB scoring is biased toward paying full up-front cost. Questions we should explore further include:

- How do innovative projects get executed within the DoD, using no tax funding?
- Who and what was the driver, at what level? How to scale?

It is evident that CGRS built a sound foundation in RT1 by establishing the ***fundamentals*** of energy (how is energy used, how it moves: from production to distribution to storage), terms (DoD vs industry terms), division of interest (e.g. OE vs IE), as well as the division of budgets (e.g. IMCOM and FAR-based vs Other Transaction Authorities). Building on that foundation in RT2, CGRS outlined how ***public-private partnerships*** were used in various energy resilience pursuits. In this final Round Table, CGRS used case studies to thread together past performance with current requirements for a review of the benefits and barriers of funding and financing mechanisms, as well as how cyber intersects with energy resilience.

CGRS Goals

Research and apply learnings at the intersections where silos meet in climate, water, energy, and infrastructure (IF):

- To enable mission readiness for MIL and CIV leadership
- To study operational energy, resilience, sustainment
- To bridge communication/semantics between MIL and CIV
- To build the roadmap for curriculum with literature review (NDAA, rules and regulations, State, Local and Federal)
- To brief internal colleagues to engage faculty
- Driving generational change: sensitizing people at each level; interdisciplinary
- Resilient Cities
- Federal Energy Management DOE Huntsville, NREL
- Desired outcomes: modular courses appropriate for each level of decision-making
- Introduce community partnerships with new IMCOM
- Garrison commander course being offered online
- What do we need to get smart about soon? Task force convenes to examine the space. Periodic policy review session (offsites)

- OE across the services - forum to discuss OE realities available, but limited impact
- What should we talk about - what's the background - what do senior leaders need to know?
- DHS cyber security summit
- But how? There is no way we are going to keep up with what industry is doing, at their speed of development
- Desire to operationalize commercial technology for military consumption
- Academia is an appropriate place to convene experts, safely and legally discuss options and make recommendations for progress
- Frequency of classwork combined with technology transfer makes partnering with academia ideal
- EETWG forum - based on project-based forums to discuss policy issues and technical issues; no one pushing advance topics for energy managers. Who is the someone that receives the "issue request". Senior leaders not necessarily making the decisions (GS-15 and O-6); acquisition community (attachment called IEO_EETWG_Quad references this organization and their recent work).
- May want to follow up to participants with information on Norwich "Pro" Program – continuing professional education offering to Garrison managers/dep managers, as well as energy managers.

Questions & Lessons Learned

- From the perspective of the Garrison Commander/Manager or authority enacting P3 r P4: keep it consistent – take the meetings with everyone--but what is the process for partnership?
- What are the tools?
- When an unusual new resilience solution is devised, it may be rejected because it is not familiar across the service.
- How do we capture the risks of all parties on formulas that tap private financing for long-term resilience investments?
    - What authorities are needed?
    - EETWG conducted a policies and regulations analysis in 2018 which can be referenced by CGRS.
    - Timing affects cost and risk – the longer the project development process, the higher cost and higher reward required may reduce access to private capital and willing partnerships.
    - Big complaint: too many costly feasibility studies with little or no action.
- Can CGRS be a long-term information bank for expertise repository, to make smart initiatives more likely to be adopted?
- But what about the failures of privatization (e.g. housing sustainment)?
- Risk Analysis: who does it, and for how much?
- 50 state utility regulations
- Dynamic knowledge base (tactics, techniques and procedures)
- There is no documented how-to manual for engagement for replicability
- Presidio upcoming events the end of October for a two-day IGO event
- Tulley (? Identify who): Army Energy Manager, fairly mature system

- What is an energy target? Certain sites with specific activities with vulnerabilities
- The question is what are the events and circumstances that facilities and communities need to recover from? Seemingly, new and extreme disasters and challenges every year.
- How do we “systemize” and “mainstream” effective models?
- Innovative funding programs - ERCIP, ESRCP, etc. – how to avoid “valley of death” issues? Where do successful initiatives go from there?
- When there is a good fit between a locality (Monterey and neighboring towns) and military facilities, how replicable is this model?
    - Profile: small city, limited distance issues, no issues with leadership support
- Note: look at all mission-essential items: where does the food come, where other the external supplies? Such logistics need to be considered for crisis planning. Islanding a base may not be the metric on which we are measuring base resiliency.
- DoD should be seeking Hill funding for new funding that could be matched to private sector funding to pay for valuable support programs in community essentials for base.
- Fort Knox needed a legislative exception; if it were done for all military installations, this would open the way to tap organic local energy services (sub-surface mineral rights owned by BLM, Department of the Interior).
- Sharing energy should be considered between base and community, and should include energy credits.
- There is a desire to stabilize the cost of energy, but the purchase of energy is variable on the spot market (e.g. Fort Drum) with high volatility and variability.
    - This variability makes it impossible to put a value on resilience
    - Raises the issue of whether the contract can be renegotiated?
    - Private company’s cost is constant
- Blend and Extend as an option of extending and enhancing the partnership: high price / low price = new price to save money, cap risk, give finance entity more years
- Public-private partnerships privatized family house (7 primary partners, dozens sizes, dozens of organizations) and 50 year contracts - private contracts $15B
- Models to review: reference EY funding mechanisms overview (e.g. Lend-Lease in Hawaii, privatization of Army lodging - 50-year contract)
    - Avoids taxpayers’ dollars
    - Lower bill in long=run with taxpayer dollars
    - Not enough money to put into IF
    - Leveraging P3 so things could be fixed faster (utilities privatization)
    - 158 utility privatization rates
    - IG reviewing additional privatization
- Enhanced use lease (excess land to current use)
    - 50-year contract: e.g. Yuma Proving Ground, Test Track with GM in Yuma, AZ for P3 hot weather T&E
    - Redstone case study for development right outside the gate: cross benefit to community and base
    - (New Hampshire case study) Drone mission with University of NH drone UAV undergrad and grad programs

- The ways in which PPA's can be used: private sector, builds, owns, manages and operates
    - Took the request to the private capital markets
    - Private recognized that Army is a good customer
- ESPC's enable savings ($3b currently) for capital purchases
    - OMB scoring (cash up front, for 20-50 year contract) is a big issue that precludes a lot of work on partnerships. Requires all money up front
- ERCIP
    - Acts like grants, jointly proposed between MIL, university and private sector partner (refer to EY PowerPoint content)
    - Ratio of savings
    - Now accepting microgrids (energy resilience)

Valley of Death

- ESTCP - no plan for longevity or sustainment
- Technology projects to test
- No long-term maintenance associated with it (case study: Eaton and Ft Custer)
- New technology concept
- SERDP: EPA & DOE partnerships
- NDCEE: more nascent technology ($25-$150M/year)
    - Run by DOE to make sure every service has a voice
- MILCON
    - Buildings (vertical facilities) have priority for MILCON
- Sustainment
    - Base has pre-calculated number for sustainment
    - "Slush" fund for base ops
    - Referred to as SRM - sustainment is a calculation, restoration and modernization due to complete upgrades/repairs
    - Sustainment does not give you restoration and modernization money - will often pull from RM to rebuild upgrades
- Restoration and Modernization
    - Different money
    - Real property records
    - Buildings in the wrong codes
- Who came out with the smart ideas, and at what level?
    - No rigorous analysis of processes and applications based on tweaking
    - Needs to be accountability in the process
- Community partner who is just as tied into the community as the DoD

Case Study: Presidio of Monterey

Former City Manager and Former COL (instructor at Garrison commander's course)

- Umbrella of protection to take chances, take risks
- City of Monterrey - near NPS

- Seaside, California - looked at it as a complex
- Public relationships = forever relationships (estimate June 1770)
- Rethink how we do the relationship - engineering & housing privatization as reference (August 1984)
- Had everything except for the money: chance worth taking
    - 100% occupied
    - Right market dynamics to make it happen
    - Stakeholder engagement, to know the market

- Help the community understand the military mission: long-term community success is tied to the long-term mission success, with no ending date
- Know your argument for your mission: understand the language and the culture of your friends
- Put together a consortium to teach the process
- Community partnerships were the tool to keep NPS open
- Leadership came from within the community
- Demonstration project to study whether MIL can purchase services from the local community
- Motivating factor: economic development strategy, partners for long-term community success
- Formed a joint power agency in the community to address the long-term services
- Intergovernmental Support Agreement: 22% treatment than alternative COAs, 41% savings, embedded in Monterrey as a partner
- Reference San Antonio Council of Governments
- It’s possible to do it: the trust grows with performance
- Someone has to
- Camp Roberts satellite installation (DLI/DoD interest) - 120 miles away (Paso Robles) employees distributed
- Leadership and management of the organization
- Do the elected support that in your organization?
- Work the problem - takes leadership and resilience
- Continuity of leadership: Net Zero by 2030 bring up to code to meet the real time needs of the Army
- Culture, Projects, O&M Processes (know your system: enforcing warranties that are not necessarily enforced by USACE projects)
- Continuously looking for savings: Operation Hot Water (needed linguists faster than IF could be built)
- City takes the rebate and applies it to the Army mission
- Follow the mission thread, from the front gate, to logistics, mission essentials past 14 days because the region has to determine what to do - must penetrate the fence line
- Consider the interdependency of the community

Barriers

- Distance is one of the challenges you've got: "the tyranny of distance"
- City of Manhattan too far away
- Size of the city in contrast to the MIL population
- Task Force to deal with resource challenges on the base?
- Shared Services: Is there a Consequence Management Plan?
- Island the mission
- State of Connecticut example: DoD wanted to island the base - make sure it covers the emergency response
- How do you balance operational continuity? State-wide bonds to enable IF developments

Opportunities

- Defense Community IF Program: Matching grants (utilities, roads, schools, telecommunications)
- Communities are creating their grant proposals
- Look beyond the fence line
- Intergovernmental Support Agreement legislation - expand to include energy resilience projects under that authority
- Peer pressure - competition mentality
- Steering the culture in the right direction - responsive to the needs of the troops
- Data tracking to increase efficiency
- OTJ training to all energy stakeholders
- Master planning first - look beyond the fence line Joint Land Use Studies (JLUS) paid for by DoD
- International city manager's program - smart cities program
- ICMA - Deputy to the Garrison CDR go to city for a fellowship; professional development curriculum for
- The role for the National Guard bases: first responders (utilities and National Guard to enable regional energy security)
- ADC: help the communities better understand the role of the service communities
- Master Planning: Maintaining mission collaboration & coordination outside the gate
- Waves Davis Bacon act, waves 8a
- Workload reduction cycle
- Level-load across several participating organizations: driving economies of scale
- Common points of failure - rigor analysis - regional threat assessment
- Proximity to cities (opportunity space), proximity to another location
- Community of the Willing: project mil into the community

Case Study: Fort Knox (Cogeneration) and Fort Drum (Biomass)

...the rest of the story…

- Nat gas extraction on base
- Mineral Rights Act - grants leases to extract natural gas

- Utility owned gas under base, had unauthorized access to the installation for additional wells
- Went to Congress and filed an exemption to the Mineral Rights Act (Fort Knox - approved last year)
- Doesn't make sense for the MIL to access natural resources within their access and management?
- Pipeline charges $18M/year saved + Kentucky
- Resilience was improved by accessing an available resource without the restrictions found elsewhere (maintaining their own pipeline pressure)
- Utilities privatization
- Possible power purchase arrangement
- The cost savings were so high, we didn't have to value resilience
- Policy and Legislation: if one base got an exemption, now every base can get this exemption
- Sub-surface mineral rights on lands, except
- 1984 regulation BLM has to get authorization from ASA before leases and Army has to approve
- Utilities privatization, working with DLA, as authorized act
- $60M under authority of utility privatization National Rural Utilities Cooperative Finance Corporation (CFC)
- The State of Kentucky knew the value of Fort Knox (had lost three quarters of mission profile after BRAC)
- Tied reduction in cost of operation
- Ground (geo) exchange: "nibbling on the edges"

Questions

- What are my legal authorities?
- How do I bundle those authorities to get what I want, so they can save money?
- What was the interest rate?
- No ability to self-finance because it's a rural electrification, within State of Kentucky
- PUC approval for system

Case Study: Fort Drum

- Stopped producing coal - sold to RE energy for biomass
- 25-year contract
- Shrub willow is a woody crop that reduces soil erosion, regrows with high BETO content
- It would have gone to landfill, and now it goes to the biomass system
- Biomass credits, retained on base, the rest sold on NYSERDA market
- Fort Drum plus community
- Forcing functions: a) Buying market on the "spot market", trading causes variability in millions in energy costs b) ability to operate for longevity and causing long-term community benefit

- Benchmarking to the variability of the market - couldn't cost the value of distribution, or risks associated with volatility
- Spot market costs reduced, so cost of paper has gone up - may have paid several million more
- Renegotiate contract, Capitol Hill, legal community
- Spot market coming from Ontario, Canada: other dynamic issues, risks of distribution
- $.03/kWh is a standby power

Questions

- Do we know if the public service commission is available?
- Is it a baseline cost?
- Could there have been more negotiation in the contract?
- There's not a bidirectional negotiation of costs after the point of contract signing? Private equity takes the risk and shouldn't be asked to eat the cost
- Some people cannot stomach the risk - termination for convenience
- Do we have the legal authority for multi-risk contracts? Army took the risk.
- What's the cost of resiliency?
- Power projection identifier - increase mission resilience for 10th mountain ID?
- What is the cost of a GW from that plant to a consuming?

Opportunities

- There's need to be the ability to use something other than taxpayer funds to finance projects
- Maybe graduate-school metrics
- Blend and extend - give more, extend more - balance the price point mix
- We don't have all the facts but what do we do different next time?
- Who was looking at the future cost of natural gas?
- How do we reconcile the cost of resiliency among various stakeholders? What is the cost of not having power projection?
- How do we calculate readiness?
- Prioritization of operations?

Case Study: USAG Detroit Arsenal

- War & Tank plant (ref: DTA material)
- Lost substation after land transferred to Warren
- CONRAIL running straight through garrison
- Enduring Missions: Futures Command (future combat vehicle)
- Blew one mile of electrical lines $36M electrical upgrades
- Without the substation, limited capacity to support mission: barrier to operations
- Demonstrate & document for proper timing and construction
- Get $ to fund energy master plan
- Very robust R&D community with interesting missions
- Dynamic modeling to include dynamic requirements - simulate models for data gathering

- This is where we are unique: ground vehicle testing for remote microgrids
- Upgrades to substation without ability to include microgrid
- Working with utility and private sector to determine
- Exercise the reality - dynamic modeling, before testing exercise
- Informing decisions with hard date - to identify the price of resiliency
- Crossover technology between OE and IE
- Take advantage of outside expertise
- Technical capability gap: form partnerships with local community college & academia to forge partnerships, + Army National Guard
- Virtual model building for site surveys
- Looking for choke points
- Difference-maker model: go sufficiently above the system level (operational technology)
- Impact scenarios need to be better vetted
- Minimize duplication among tenants on the garrison?
- It's not a static environment so we need to account for fluctuations?
- Share multiple points of failure with Selfridge AFB
- Difficulty for P3/P4 process and funding
- Bostonia is ESTCP provider: may request special input from POC

Questions

- Capability gap in-house, who is going to design?
- Can we "un-silo" this to minimize duplication and re-engineering?
- Can we use OTA on the installation?
- How do we deconflict policies and funding mechanisms with emerging / changing requirements
- How does dark fiber get used to lock down resilience?
- How do you handle emergency and disaster scenarios when there are millions of dollars needed for infrastructure upgrades to get facilities to par?
- How does the energy master plan work with installation master plan?
- How do we bundle things we already doing and make them more efficient?

Case Study: Army Office of Energy Initiatives

- Attorney Dominic Frinzi was attorney and represents OEI
- 4MWhr battery = .06 acres of land
- Mr. McGhee is leading this pursuit to use batteries vs land for renewable energy production
- Requires fair market value of interest granted (vs highest and best use)
- Propose a process with a transparent valuation
- Capacity sales agreement for a battery compared to another approach for analysis
- Ref: BLM has established battery pricing
- Ref: FERC order 831
- OEI paying for NEPO

CGRS INPUT: Funding Mechanism Closing Questions

How do you fund the development of resilient systems prior to a crisis event?

How should we measure and value resilience?

Response 1

What is the current level of effort/prioritization to implement geothermal technology to achieve energy resilience?

Comment--course curriculum must look at a comprehensive education process for mid and senior grade military and civilian personnel in terms of:

- how to properly and legally partner with private entities (use lawyers)
- overcoming the tyranny of transition between commanders and senior officials for programs “long term strategies

Response 2

Measuring the value of resilience

- should be tailored and based upon the mission that is being supported, in other words, is “at risk” without resilience
- I assert that measurement should be aligned with readiness metrics, i.e. time, number of days, number of hours, percentage of power available, percentage of LOC’s, etc.
- So, essentially, we measure the value of resilience in terms of the degree that the mission is degraded per loss of given metrics (number of days, number of hours, percentage available power, weapon system readiness)

Response 3

Measure and Value Resilience

- Rank the importance of military mission readiness to respond
- Present a worst case (100 year?) scenario and explain how it will impact military mission readiness to respond
- Determine the cost of mitigating/preventing the worst case scenario

How to fund prior to a crisis?

- Basic sales strategy: FUD (Fear, Uncertainty, Doubt)
- Present the worst case scenario to the chain of command
- Make the case with a facility that it is likely to have a “100-year event” soon. Pick a facility that is obviously in danger. Get that facility funded for resilience in a manner that can be duplicated. Do it again and again until it is viewed as a standard requirement

Response 4

Measuring the value of resilience

Measure relates to:

- reduction of risk from natural or man-made disruptions; must identify vulnerabilities

Value relates to:

- opportunity cost of mission capability lost due to disruption, and
- literal dollar cost of any work-arounds or repairs that would have been avoided had resilience measures been in place

How to fund prior to a crisis?

- examine advantages of public-private partnerships where competent, reliable non-military services are supplied by private (or municipal) partner, if services are to specifications and save funding and manpower
- examine power purchase agreement with appropriate sharing of risk and advantages over not doing it
- look at O&M to buy aspects of resilience as a service--perhaps can't do with functions that are sensitive and/or essential

Response 5

Value of resilience

Determine the cost associated with a power loss, i.e. damage to equipment, employee productivity etc., and develop a kwh price based on likelihood of power loss (and perhaps discount).

How to fund

Take advantage of third-party financing vehicles (UP, ESPC, UESC, EUL etc.) and leverage them with appropriate funds

Case Study: Fort Drum

- How was funding from U.S. Department of Energy's Bioenergy Technologies Office (BETO) sourced for this project? Was it through ReEnergy?
- Project origination—is the market driving these improvements? Who approached whom, ReEnergy or Fort Drum?
- They couldn't value the volatility? Why not?
- Spot market energy from Canada
- Market distortion
- Even though the Federal government is creditworthy, getting the deal is difficult
- Need funding mechanisms other than taxpayer funding
- "Blend and Extend" risk sharing to mitigate the risk of out of the money forward contracts
- Power purchase arrangement is a commodity arrangement

- Holistic prioritization of the mission, base to base

Case Study: Fort Knox

- 15 other bases with natural gas under base
- Project origination—did the utility, base or Army initiate this particular project?
- What aspects of the project were innovative?
- Was the feasibility of the project ever in doubt? Were there any alternatives to the National Rural Utilities CFC loan? And prior to receiving the loan, was the project going forward or not?
- No alternative to this. State recognized the value of Ft. Knox, PUC was involved
- Ability to expand without having to buy the land
- An 8-year payback period—for which stakeholders does this metric matter?
- ROI--congress wouldn't support it, wouldn't fund resilience
- Was battery storage incorporated into the power system?
- Was the 2009 ice storm power outage the primary justification for the project?
- High temperature geothermal
- Ground heat exchange
- Subsurface rights are an issue, BLM owns

Detroit Arsenal

Miscellaneous Questions
Deal origination--who creates (funds, packages, feasibility) these PPP energy deals?

How do you fund resilient systems prior to a crisis event?

Given a stable mission at the installation level and changing political and associated funding environment, how should installations view (monitor, analyze, identify opportunities) the funding landscape from a strategic perspective?

Discuss the convenience-resilience tradeoff as it relates to the mission.

Energy Savings and Energy Resilience: how are the two related? How can energy savings and resilience investments be bundled together?

- The business case for resiliency is strongest when it builds on existing assets or piggybacks on infrastructural investments the organization is planning to make in the near future.
- Investments in resilient power systems can become more attractive if system owners establish monetization pathways in dynamic energy markets --Amaresco WP
  --how do these points apply to the Military?

For a business: the resiliency value is primarily calculated by determining the value of each hour of downtime if production is curtailed and weighing that against the cost of the CHP system.

For organizations: the value of resiliency by calculating the cost of impacts such as disruptions to training schedule, water/mold damage to facilities lacking air conditioning, or others.

Cyber-Energy Curriculum Gap

As we look at energy resilience component pieces we have uncovered and area of cyber--significant and growing factor, no academic programs focused on SCADA/ICF, no accepted certifications for this area, further if cyber command is the definitive military authority, this needs incorporated at cyber.

Appendix 2: Norwich University Stakeholder Briefings

CGRS Energy Track NU Stakeholder Roundtable: May 9, 2019

The purpose of the NU Stakeholder Roundtable is to present the CGRS Energy Track to interested faculty and other NU stakeholders with the goal of successfully implementing the Energy Track's comprehensive roadmap at NU and beyond. The NU Roundtable will provide a forum for communication between NU stakeholders, policy makers and subject matter experts regarding the progress of the Energy Track and will focus on implementation and sustainability.

What is the "Energy Track?"

A "roadmap" toward the development of a curriculum that underpins operational and installation **energy resilience** that:

- Supports CGRS's mission of "resilient community building" through **research and technology driven, innovative, and hands-on curricular enhancement** in the energy sector
- Explores the intersection of ***technology, policy, and sustainment***
- Promotes ***mission readiness of future military and civilian leaders*** & currently deployed forces

Military Definitions and Resources

The Energy Track has a military impetus. But because energy resilience cuts across all sectors, the outputs of the Energy Track will be accessible and beneficial to all stakeholders.

Operational Energy: *the energy required for training, moving and sustaining military forces and weapons platforms for military operations (see 10 USC 2924).*

Installation: *a base, camp, post, station, yard, center, or other activity under the jurisdiction of the Secretary of a military department or, in the case of an activity in a foreign country, under the operational control of the Secretary of a military department or the Secretary of Defense, without regard to the duration of operational control (see 10 USC 2801).*

Resiliency: *the ability to anticipate, prepare for and adapt to changing conditions and withstand, respond to and recover rapidly from disruptions.*

Office of the Assistant Secretary of Defense for Sustainment: ENERGY
https://www.acq.osd.mil/log/ENR/index.html

Agenda in Brief

9:00-9:15 Introduction
9:15-9:30 CGRS and Energy Track
9:30-9:45 Debrief from Round Table 1 Energy Fundamentals and Threat Vectors: April 3-4, 2019, Washington, DC
9:45-10:15 Questions and discussion
10:15-11:15 Interactive Exercise
11:15-11:45 Priorities and Next Steps

11:45-12:00 Closing

Norwich University Energy Track Out Brief and Roundtable – hosted by CGRS

What: Norwich University Energy Track Out Brief and Roundtable – hosted by CGRS
When: 8 November, 2019 from 10am to 2:30pm
Location: Norwich University, Multipurpose Room (MPR) in Kreitzberg Library and Dial-in for remote personnel (please see invitation for dial-in details)

Background:
In March 2019, under NUARI's leadership, CGRS and other sub-contracted subject matter experts (LkM, EY, BCG-Maya and specialists in their networks) began working on "Development of an Energy Track within the Norwich University Center for Global Resilience and Security"[2].

The contract, overseen by the US Army ERDC-CRREL and USARMY CEERD-CERL was to develop the CGRS Energy Track—a program focused on building the educational foundation for energy resilience at military installations and more broadly in the municipal, state, national and global ecosystems within which they exist. This phase (Phase I "PLAN") of the Energy Track included planning a literature review, stakeholder engagement, roundtable events, and workgroups to investigate, analyze and disseminate information regarding energy security initiatives, best practices, and standards. The CGRS Energy Track was seen as a foundational step to use the energy resilience education model to eventually address the operational and economic realities of water, waste, and agriculture in subsequent phases of this program development.

The three roundtables conducted in compliance with the contract, all held in Washington DC were:

1. Energy Fundamentals: April 3-4, 2019
2. Public Private Partnerships: June 18-19, 2019
3. Funding Mechanisms and Cybersecurity: September 23-24, 2019

Scope of the Nov. 8 meeting:
The purpose of the *Norwich University Energy Track Out Brief and Roundtable – hosted by CGRS* is to share the highlights of the discussions and takeaways from roundtables 2 and 3 held in June and September 2019 in Washington DC, administered by the US Army Energy Research and Development Center with the Norwich Academic teams (on-campus undergraduate, online undergraduate, graduate, Norwich Pro, and NUARI) and other NU stakeholders[3].
The work underway in this PLAN phase of the contract has underscored the need for a university-wide Energy Track that leverages the capabilities of NU across the undergraduate, graduate, on campus, and online levels and the importance of furthering the partnership with PLAN phase SMEs and networks to create strong educational partnerships for experiential and research activities.
Therefore, in the November 8 meeting we will also solicit feedback from the Norwich University units to helps us successfully implement the Energy Track's comprehensive roadmap for installation and operational energy resilience education at NU and beyond (see attachment 2 for a draft roadmap). The Out Brief and Round Table on 8 November will provide a forum for

[2] A list of abbreviations and some key definitions are included in Attachment 1
[3] An out-brief of roundtable 1 discussions and takeaways was held at Norwich University on May 9, 2019.

communication between NU stakeholders, policy makers and subject matter experts regarding the progress of the Energy Track and will focus on implementation and sustainability.
Goals and expectations from this meeting:

1. Use discussions to finalize the roadmap (draft in attachment 2).
2. Determine interest and extent of participation of stakeholders in implementing the Norwich University and CGRS Energy Track.

Agenda in Brief:

- 10:00-10:15 Introductions
- 10:15-10:30 CGRS and Energy Track
- 10:30-11:00 Debrief from *Round Table 2: Energy Resilience and Public Private Partnerships* and *Round Table 3: Energy Resilience and Funding Mechanisms, Cyber* – case studies
- 11:00-11:30 Questions and discussion
- 11:30-12:00 Interactive exercise
- 12:00-12:30 Priorities and next steps
- 12:30-14:00 Closing and break-out sessions
    1. Incorporating energy resilience modules into current course offerings
    2. Energy Resilience and Goal 7: Capstone
    3. Online and traditional collaboration via the Energy Track: hybrid classes and concentrations
- 14:00 – 14:30 Conclusion

Attachment 1: Abbreviations and Definitions

An explanation of abbreviations used in this document and some definitions of terms are provided below:

Abbreviations (in order of appearance):

CGRS: Center for Global Resilience and Security
NUARI: Norwich University Applied Research Institute
LkM: LkM or Last Kilometer
EY: Ernst and Young
BCG-Maya: Boston Consulting Group – Maya
ERDC-CRREL: Engineering Research and Development Center (*ERDC*) - Cold Regions Research and Engineering Laboratory (CRREL)
CEERD-CERL: Corps of Engineers Engineer Research & Development (CEERD) Center Construction Engineering Research Lab (CERL)
NU: Norwich University

What is the "Energy Track?"
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Attachment 2: **Draft Roadmap for "Development of an Energy Track within the Norwich University Center for Global Resilience and Security"**

The final deliverable of a roadmap for the development of an Energy Track within the Norwich University Center for Global Resilience and Security (CGRS) will result from extensive literature review, conversations with experts across sectors, in three separate roundtables, and discussions with cross-sectoral experts in the areas of energy resilience, with a specific focus on the installation and operation areas.

We envision the following for the CGRS Energy Track roadmap:

1. Energy resilience is centered in the intersections between technological advancements, mission readiness, and human centered design (Please see figure 1).

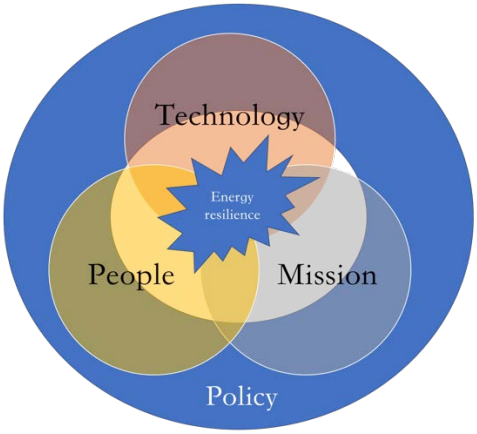

Figure 1. Energy resilience track at CGRS

2. As policy drives technological innovations, as well as mission readiness, and human impacts, we consider it to be a core component of each of these three areas, that influence energy resilience.

3. The roadmap will help us develop a circle of experts made up of faculty and external experts, who will help us review existing literature to determine state of the art theory and practice related to the area of energy resilience, focusing on installation and operation. This group will also enable the track's efforts in:
    a. ***Education:*** Undergraduate, and graduate students, as well as high school students will be engaged through classroom, seminar, and laboratory activities related to installation and operational energy resilience.
    b. ***Research:*** This will entail engaging in original research, collaborating with other educational institutions, federal and state labs and research centers, with a view to publishing findings in peer reviewed literature, white papers, presenting at conferences, and participating in competitions such as the "Hack for Defense"

c. ***Dissemination:*** Advanced knowledge and research findings will be disseminated through seminars, workshops, and conferences for students and leaders in the military and non-military sectors.

4. The roadmap will be produced through mechanisms noted above:
    a. The three roundtables, on energy fundamentals, public-private partnerships, and financial modeling.
    b. Surveys that will be administered to various stakeholders to inform the pre and post roundtable discussions.
    c. Engagement with related non-military entities that influence energy resilience, and are involved with the installation and operational energy resilience issues from a non-DoD perspective. For example, local utilities, nonprofit organizations, private businesses, industry leaders in the areas, and academic institutions already working on these issues. This includes a review of published reports and literature in this area.
    d. A thorough review of the Norwich University curriculum, focusing on all coursework that covers any aspect of energy resilience.
    e. A working group of Norwich university faculty, and other colleagues (including external partners), who have the potential to influence the curriculum and provide opportunities for students to engage in hands on education in the areas of energy resilience. The working group will also be used to recommend changes to the curriculum, following the findings of the roundtable conversations, and helping CGRS come up with a blueprint of bringing the curricular changes to the university committees responsible for approving these changes.

5. It is expected that the final roadmap will result in:
    a. Publications
    b. White papers
    c. Potential development of a new academic major/minor(s)
    d. Certificates
    e. Student and faculty research

Norwich University Energy Track: Internal debrief of November 8, 2019
Meeting notes and takeaways

Introduction:

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The three roundtables conducted in compliance with the contract, all held in Washington DC were:

4. Energy Fundamentals: April 3-4, 2019
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The work underway in this PLAN phase of the contract has underscored the need for a university-wide Energy Track that leverages the capabilities of NU across the undergraduate, graduate, on campus, and online levels and the importance of furthering the partnership with PLAN phase SMEs and networks to create strong educational partnerships for experiential and research activities.
Therefore, in the November 8 meeting we will also solicit feedback from the Norwich University units to helps us successfully implement the Energy Track's comprehensive roadmap for installation and operational energy resilience education at NU and beyond (see attachment 2 for a draft roadmap). The Out Brief and Round Table on 8 November will provide a forum for communication between NU stakeholders, policy makers and subject matter experts regarding the progress of the Energy Track and will focus on implementation and sustainability.
Goals and expectations from this meeting:

3. Use discussions to finalize the roadmap (draft in attachment 2).

[4] A list of abbreviations and some key definitions are included in Attachment 1
[5] An out-brief of roundtable 1 discussions and takeaways was held at Norwich University on May 9, 2019.

4. Determine interest and extent of participation of stakeholders in implementing the Norwich University and CGRS Energy Track.

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- 10:00-10:15 Introductions
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- 11:30-12:00 Interactive exercise
- 12:00-12:30 Priorities and next steps
- 12:30-14:00 Closing and break-out sessions
    4. Incorporating energy resilience modules into current course offerings
    5. Energy Resilience and Goal 7: Capstone
    6. Online and traditional collaboration via the Energy Track: hybrid classes and concentrations
- 14:00 – 14:30 Conclusion

Notes (by CGRS student Fellow – Mallory Dutil):

- Energy and operational meeting and review work, final operational meeting
- How to create educational components for the next generation
- Professional development at the master's level
- CGRS presentation for energy & discussion:
    - Intersections of climate, water, energy, and infrastructure
    - End goal is to build a road map for the energy resilience curriculum
    - Road map includes curriculum, experiential/hands on experience, technology partnerships, resource requirements
    - The Resilience Dividend" by Judith Rodin, Public Affairs, 2014, ISBN – 1610394712
    - Round table 1: recognizing that curriculum for the different entry points will still require the coverage of a certain amount of fundamentals, followed by specialized materials that may be level-specific. The road map will have to be diverse in each of the various disciplines and the following delivery programs
    - Round table 2: Public private partnerships in Army. One of the ways a government can deliver new infrastructure. Private sectors find capital to build the infrastructure, government pays PPP operator to run the infrastructure for a set period.
    - Round table 3: Funding mechanisms and cyber. ID and asses funding mechanisms and financing that can support operational and installation energy resilience. Determine impact of policies and directives prioritizing and performing resilience actions. Explore cyber-physical threats and vulnerabilities that challenge operational and installation energy resilience.
    - Key takeaways: interdisciplinary teaching and learning is key, including military-civilian cross pollination. Awareness is very important at the undergraduate level.
    - What is needed: a neutral party (NU) that doesn't have an agenda except having a space to bring together government and industry to foster conversations to create a continuous feedback loop
    - This is an army initiative, but it is a whole government issue that needs to be addressed.
    - NU interdisciplinary course offering draft, figure out what is to offer and where to go next
    - Box degree programs that are very descriptive and what is needed is a little more of picking and choosing from certain areas (more likely a certificate than degree)
    - Need a wide and diverse set of experts that understand the DOD/army side, policy & regulations, sociocultural operations
    - How do we develop an audience: develop several models and use the entry level, mid-career, senior leaders, and research?
    - Classes that connect the science of energy and apply to a broader scope (political science for them to write policies on energy) in order to make the students more well versed for energy conversation in various disciplines
    - What level of scientific basis will a non-science or non-engineer major need for this entry level energy course? Literacy at the various levels and knowing limits
    - Need to know what's already being taught on campus (Ex: intro to geo section on climate change and energy)
    - Courses dealing with waste products of energy production, how distribution is made and secured, and the infrastructure for development
    - Possibilities of having an online adjunct teach additional courses where NU doesn't have the space, time, or faculty to support
    - Tailor several of the current master's levels courses based on the need to address the issues brought up in this function
    - Has to be a value to the open market to come and enroll or seek this type of education

- What is the core values that any energy worker needs to know (base componentizes) and then how to do you go above and beyond into the specialized fields for different jobs?

Reflections post meeting (emailed to team on 11/11/19) by Mark Parker, CGCS

"Two [degree completion programs] that stand out to me as potential matches to energy resilience are the B.S. in National Security Studies (NSS) and the B.S. in Criminal Justice (CJ). One of the main foci of the NSS program is global and domestic threats to the United States and the means of anticipating and planning for them. By its nature it's an interdisciplinary program, so energy resilience would likely complement the core curriculum.

At this time the NSS program does not have any minors/concentrations, but it does require students to fulfill 18 credits of degree electives. If one of the options you were to pursue is a designated Energy Resilience course, it might be a good choice for students in the program.

With regard to CJ, our online BS degree completion program has an optional specialization in Intelligence & Security Management, with coursework in areas such as Homeland Security & Intelligence and Security Coordinator & Collaboration. Here too a designated course in Energy Resilience might be a good fit.

Aside from building a dedicated course, another approach might be to integrate Energy Resilience into one or more of the existing courses. For instance, the BS program in Strategic Studies & Defense Analysis (SSDA) has a required course SCIE 310 – The Scientific Basis of Sustainability (3), that is already structured around the use of data in sustainability science, including those aspects that relate to human-engineered systems. Although I would need to consult with the course developer/SME on this, it would seem that energy is one of the systems that would naturally fall under the scope of inquiry in the course.

Beyond this, there may be some merit in reaching out to the chairs of individual programs in the other colleges (in addition to Engineering) to see if there may be similar opportunities to introduce elements to various curricula (I'm thinking in particular of the case study model you followed for your focus groups). This would give us in CGCS an opportunity to look for ways in which we might be able to use our capabilities to support activity in the other colleges and perhaps – at least in the beginning – ease the time commitments of the faculty somewhat by offering digital content and delivery options to complement the in-class work."

Major Takeaways:

1. The Energy Track must be built on the foundation of assessing three key items:
    1. What roles in DoD demand what levels of proficiency in energy resilience?
    2. What is the educational background and energy resilience literacy of those employed in these positions currently?
    3. What kinds of energy resilience education gaps exist in current curricula that prevent those employed in these roles to perform their functions effectively?

2. These questions underscore the success of the PLAN phase of this project, where our goal was to develop a roadmap for energy resilience curriculum, because they set a path for the next DESIGN phase of this work, where we will be able to answer these questions and create the curricular options.

3. The synergies of this Norwich University Applied Research Institute (NUARI) led consortium of the Center for Global Resilience and Security (CGRS), College of Continuing and Graduate Studies (CGCS) CGCS, and Norwich Pro platforms and the broad range of subject matter experts who participated in RT1, 2, and 3 and those that could not participate, but are part of the 200 year old Norwich University network, are ideally placed to research the questions posed above to be able to work on the next DESIGN phase of this work.

4. This debrief also allowed the NU energy team to begin deliberations on existing curriculum across the university where the energy resilience modules may be integrated/embedded as a way to enhance existing offerings to promote energy resilience education at the entry level (undergraduate and undergraduate degree completion) and mid-officer levels (graduate school courses).

5. For example, Dean Clements of CGCS advised developing an overall list of competencies necessary to be proficient in energy resilience from a military installation and operational perspective as well as civil municipal perspective; develop modular curriculum in these areas, and then determine the grouping of various modules to meet the proficiency requirements of various job positions, as a way to offer a flexible pathway for both new and existing employees tasked with energy jobs. Some examples of doing this came up immediately as Ro Pelletier of CGCS offered the ability to mix and match various units within existing graduate programs in public administration, information security and assurance, etc. to build a custom program that is relevant for energy mangers looking for specific energy literacy or technical skills.

6. Mark Parker of CGCS made several recommendations (please see notes) on behalf of courses and programs currently part of the CGCS offerings and ones where the graduate school can work in collaboration with the undergraduate program to strengthen.

7. Undergraduate faculty Laurie Grigg, David Feinauer and Simon Pearish brought up some of the challenges of developing new courses or adding anything new in curricular programs that are already high on the number of total credits. There was also an acknowledgement that

events like this debrief created the opportunity to learn from each other and swap modules/curricular components with each other. For example, Grigg was planning on covering a unit on energy units in her upcoming course on "Energy and the Environment" in spring 2020. As Feinauer already covers energy units as part of the freshman engineering course he teaches, he offered to send Grigg the necessary materials. Ed Schmeckpeper, chair of civil engineering and construction management brought up a new course on infrastructure that a faculty member (Moses Tefe) is developing that could easily integrate energy resilience modules. Kahwa Douoguih immediately sent Schmeckpeper and Tefe the case studies that discussed energy resilience in multiple ways during RT3, which could be easily folded into the infrastructure course. This collaborative spirit is NU at its essence, and we envision using these models of practice as a regular component of the DESIGN phase of this project.

8. In terms of sustaining the Energy Track efforts on the various platforms, in addition to the DoD customers, Clements with CGCS also noted that as NU is in the verge of being included in the Council of Independent Colleges, the consortium offers opportunities of curricular exchange and a possible market for the courses, certificates and other products that come out of this project.
9. After the NU Faculty Round Table, electrical engineering students Brian Betz, Christian Hirsch, Nick Fortuna and Alexandria Spezia presented their final senior capstone project to Eric Dunn, Viktoria Gisladottir and Kahwa Douoguih. The students will be designing a microgrid for the National Guard Armory located on the Norwich Campus. The goal for the building is to maintain its core functionality for 14 days in the event of a disconnection from the grid. The students are also in the process of mapping the electrical systems on campus, with the long term goal of designing a campus-wide microgrid. The presentation took the form of an interactive question and answer session. The student team was well-prepared, professional and engaged. Because of the vast breadth and depth of this exercise, Viktoria suggested that the students clearly bound the scope of their project to something achievable for the year.
10. General notes:
    1. Audience – the identification of the education opportunities in both the installation and operational environments is a foundational element of the next phase of the project. Some draft concepts include the following:
        - Installation – Garrison Commander and Deputy to the Garrison Commander, Director of Public Works (to include the master planners, energy managers, work order team), Director of Training and Mobilization, Contracting, Director of Logistics, Director of Information Management
        - Operational – this environment includes the assets to support pre-deployment, deployment, employment, and redeployment of any Operations unit. Training opportunities include the unit to be deployed and the elements that support pre-deployment and deployment assets such as housing, supply chain, transportation, security, power generation, range operations and cyber/information operations tasks. The deployment tasks include the transportation assets, departure and arrival ports, and the security and transportation assets to get the units to the operational area. The employment focus is on the security, supply chain, cyber, and operational units that

requires resilience capabilities such as military police, generator mechanics, the staff operations team, as well as the command structure.

2. "The Resilience Dividend" by Judith Rodin, Public Affairs, 2014, ISBN – 1610394712 proposes the following framework that could be part of the education framework:
    - Awareness
    - Diverse
    - Integrated
    - Self-regulation
    - Adaptive
3. Scientific literacy – consider the requirements and design of a foundational "energy" course that non-scientists could use to support their particular function. A notable point from the conversation on 8 November included the knowledge of how to ask the correct questions in order to support an energy resilience effort.
4. Pilot program – consider the following options in the development of a pilot program(s) for Phase 2 – Design/Development:
    - Seminar – possible residence or hybrid residence-online session for senior leaders in both the installation and operational categories.
    - Norwich Pro online course – public-public partnerships, energy master planning
    - Undergraduate certificates and/or degrees
    - Graduate certificates – 12 credits – Leadership and Crisis Management and Cyber vulnerability management (or other course)
    - Graduate degrees - TBD