Department of Defense Installation Energy Resilience

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DoD Energy Resilience (ER)

Acquisition, Technology and Logistics

❑ Policy Drivers

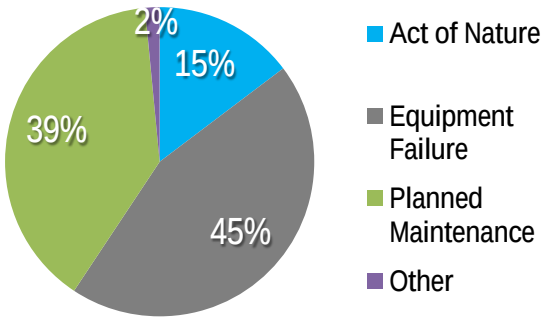
- Multiple requirements through FY2017 NDAA;
- DoD Instruction 4170.11(updated 16 Mar 2016), Installation Energy Management, Energy Resilience
- Title 10, Section 2925(a) (modified thru FY2016 NDAA);
- ASD(EI&E) Memorandum on Power Resilience;
- Unified Facilities Criteria (such as Electrical Series)

❑ DoD Policy Initiatives

✓ DoDI 4170.11 change on energy resilience (complete)
  - ✓ Ensures performance against existing requirements
  - ✓ Encourages cost-effective solutions to improve mission assurance

- Implementing guidance
  - ✓ Operations, maintenance, and testing (OM&T) (complete)
  - ✓ Energy resilience, mission integration, metrics (in-progress)
- Budgetary execution
  - ✓ Business case analyses (BCA) framework (MIT-LL) to prioritize budget resources or alternative financing projects for energy resilience (complete)
  - ✓ Rating alternative financing projects to accelerate adoption of energy resilience projects – Defense Energy Resilience Bank (DERB) (in-progress)

FY 2016 Utility Outages



- *Utility disruption data is required under Title 10, 2925(a)*
- *Disruption data informs on-going metrics guidance*

Details on OASD(EI&E) Energy Resilience Initiatives:
http://www.acq.osd.mil/eie/IE/FEP_Energy_Resilience.html

DoD energy resilience is the ability to prepare for and recover from energy disruptions that impact mission assurance on military installations.

Energy Resilience Overview
Inclusion of Mission-Based Decision-Making

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Critical Mission Operations (Sample - For Training Purposes Only)			
Global Intelligence, Surveillance, and Reconnaissance (ISR)	Power/Force Projection – Mobilizing, Deploying, and Demobilizing	Strategic Command Communication - Command and Control	Life, Health, and Safety Operations

❑ Step 1 – Criticality of mission and supporting functions

- Services and Defense Agency provided during Power Resilience review in 2014
- Validated through MIT-LL was the need for broader and strategic energy resilience framework, inclusive of:
  - Service and Defense Agency Warfighting Missions
  - Emergency, Recovery, and Response Missions
  - Supporting Installation Infrastructure (those needed based on outage risks and interdependencies)

❑ Step 2 – Mission requirements of those critical mission operations

- In terms of 'resilience' – what disruption risk is appropriate? (e.g., availability, downtime, etc.)

Important questions:

- Mission operator coordination?
- Were mission dependencies evaluated?
- Were mission-to-mission solutions reviewed and identified?
- Were risk-based mission requirements developed and considered?
- Is an infrastructure solution required or needed?

DoDI 4170.11 requires alignment to critical energy requirements (critical mission operations) and allows for expanding solutions beyond standby generators.

Resilience allows for a comprehensive, strategic framework and extends beyond traditional "building-by-building" or "generator-by-generator" designation for resilient designs. Important to establish a holistic and strategic resilience framework that integrates mission and installation stakeholder communities that encourage mission-based decision-making.

DoD Energy Resilience
Base-Level Critical Loads Example – Base Grid

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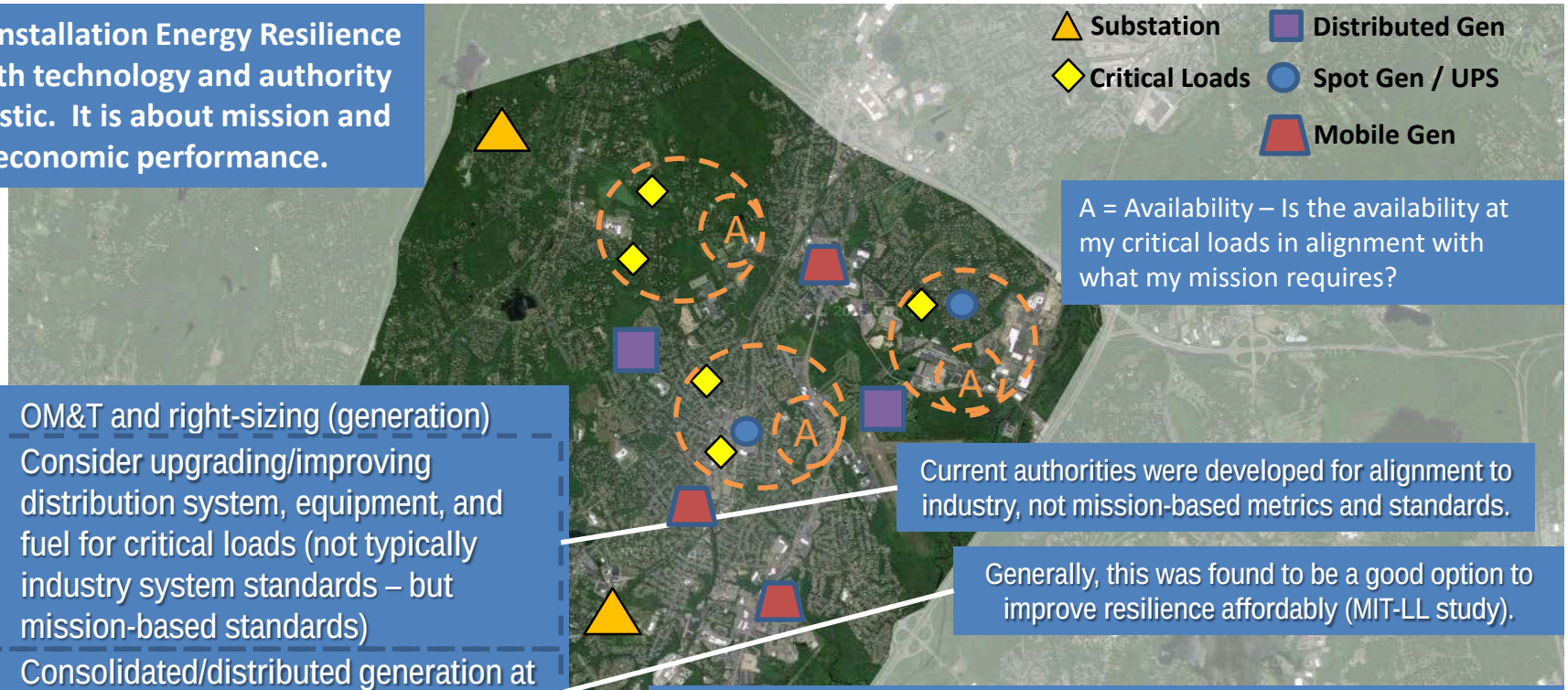
Example Case – Not an actual installation (solutions will vary based on mission requirements of military installations)

DoD Installation Energy Resilience is both technology and authority agnostic. It is about mission and economic performance.



A = Availability – Is the availability at my critical loads in alignment with what my mission requires?

- OM&T and right-sizing (generation)
- Consider upgrading/improving distribution system, equipment, and fuel for critical loads (not typically industry system standards – but mission-based standards)
- Consolidated/distributed generation at the critical feeder on the base
- Spot generators/UPS at specific critical facilities could still be required
- Essential to ensure mission-specific security requirements are met (resilience requirements allows for lower surface area protection)

Current authorities were developed for alignment to industry, not mission-based metrics and standards.

Generally, this was found to be a good option to improve resilience affordably (MIT-LL study).

- Renewable energy options can also be considered to help offset fuel related costs and vulnerabilities (however, based on local resource constraints and batteries beyond UPS generally difficult to support thru LCCA)
- Typically, we look at "fixed" energy systems – evaluation of flexible options (e.g., duel-fuel) and even mobile generation (lowers vulnerability surface area further)

Bottom-Line Up Front (BLUF) Study Results Overview

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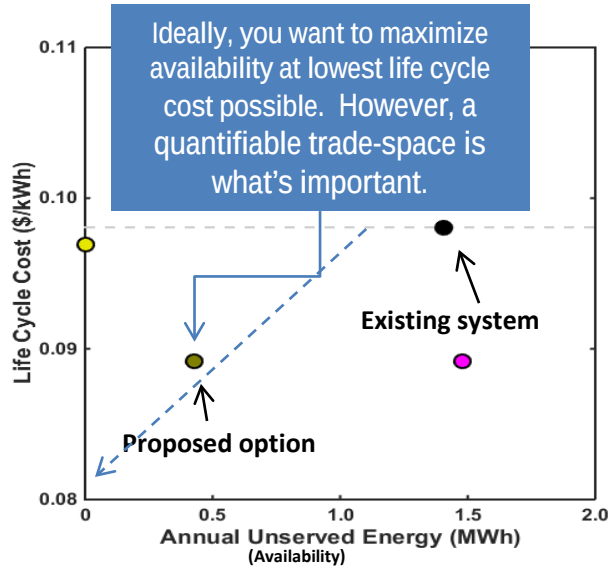
Cost attribute: life-cycle costs ($/kwh)
Mission attribute (availability): annual unserved energy (MWh)



Findings/Results (generalized)

- Critical Energy Loads: 6 MW to 21 MW
- Generators: 50 to 350 generators
- Reductions in costs: 0.2¢/kWh to 2.2¢/kWh,
- Availability improvements: 0.3 MWh to 1.2 MWh
- Base characteristics: Isolated location with frequent outages, integrated/urban base with reliable power, etc.

	Generator	Microgrid	UPS	PV	CHP	FC
●	x					
●	x	x	x			
●	x	x	x	x		
●	x		x	x		
●	x			x		
●	x	x		x		
●	x	x	x	x	x	
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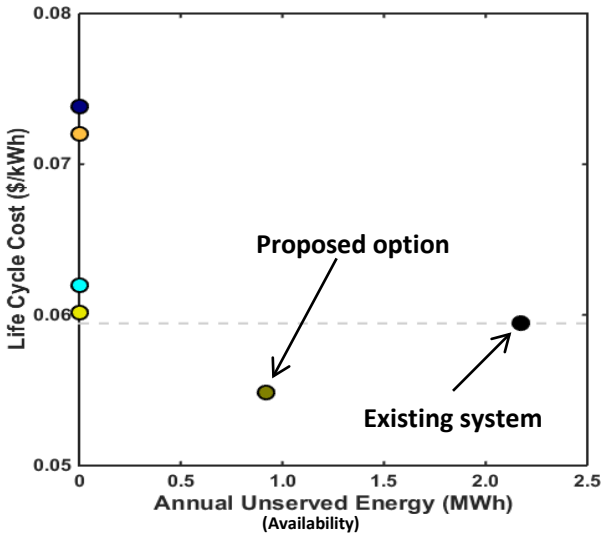
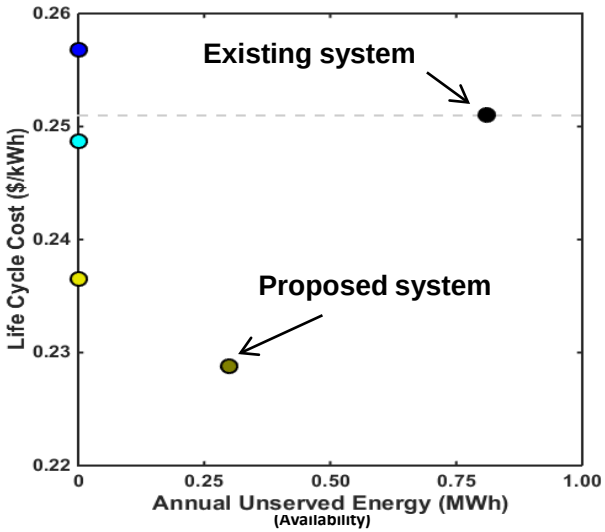
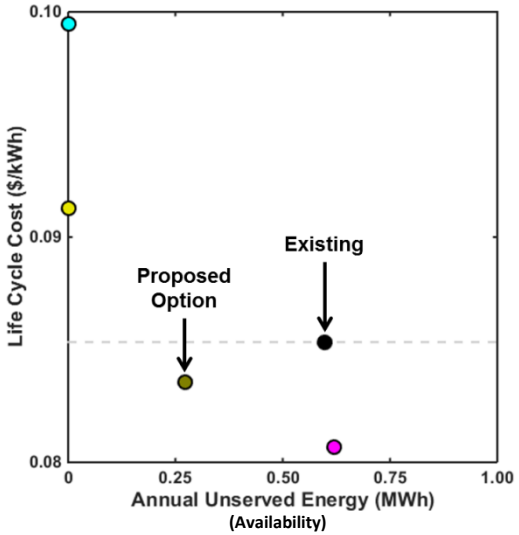
●	x	x	x	x	x	x





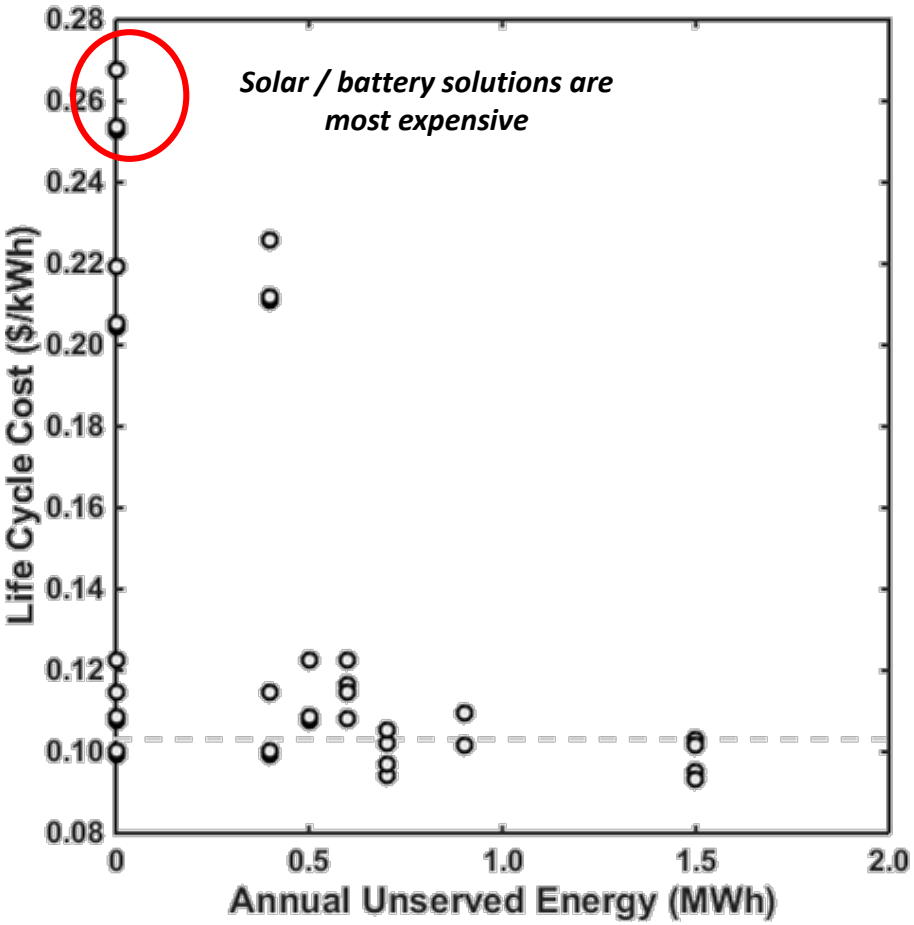
Framework allows for quantifiable tradeoffs between cost and mission assurance attributes.

Results across diverse bases indicate that more cost-effective and reliable energy resilience solutions exist to support critical mission operations on our military installations.



Model Results

- 1000 annual Monte Carlo simulations performed
- Life-cycle cost (LCC) is calculated over 10 years
- Unserved energy is based on typical outages experienced by the installation, and those expected by technology mix
- High-cost options typically include advanced/large-scale microgrids (leading to large-scale distribution system upgrades), battery integration, and/or fuel cells
- Low-cost options include generators, targeted/centralized generators and/or microgrids, and/or solar (near the point of use – focused on mission requirements)



DoD-Wide Recommendations

Similar Findings from MIT-LL Study

These are not necessarily new requirements – further prioritization and awareness is required within the installation energy portfolio.

- Communication
  - Encourage routine meetings between installation energy leads and mission operators to determine and prioritize 'critical' mission operations and energy requirements across the entire base
    - Improve guidance to determine prioritized energy load calculation for critical mission operations
  - Coordinate and collaborate throughout the base to ensure critical interdependent mission requirements are met during energy outages
- Technical
  - Understand your current energy systems and infrastructure; do not site energy systems on unreliable grid
  - Prioritize/ensure energy resilience systems are only placed on critical energy loads and appropriately sized
  - Standardize a process to ensure OM&T of energy systems (e.g., generators, UPS, etc.) for full reliability picture, and to help determine baseline resilience metrics to inform future decisions
- Cost and Performance Data
  - Encourage tracking of the appropriate cost data (capital, operation, maintenance, and testing) of energy generation and infrastructure to replicate and justify the business case for future energy resilience decisions
  - Encourage tracking of performance data that aligns to mission and availability/reliability of energy systems and infrastructure (outage data, failure rates, etc.) to assist in tradeoff decisions between cost/mission
    - Helps to identify cost-effective and prioritized remediation for reliability risks on the base's distribution system
    - Allows for development of performance metrics (availability, reliability, and cost metrics for use in RFPs, contracts, etc.)

These recommendations continue to shape policy across the DoD through continued collaboration with the Military Services and Defense Agencies.