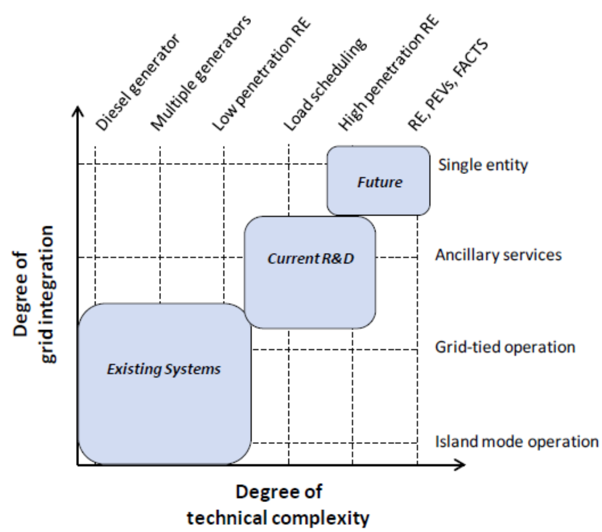
Military Installation Energy Resilience and Microgrid Overview Paper

While not widely implemented, there are some microgrid demonstrations on military installations. Since the implementation of microgrids on installations is not mature, there are still a number of challenges to commercialize microgrids, and different definitions for what constitutes a microgrid. DoD commissioned MIT Lincoln Laboratory (MIT-LL) to conduct a microgrid study in 2012[1], the study defined a DoD installation microgrid as, "A DoD installation microgrid is an integrated energy system consisting of interconnected loads and energy resources which, as an integrated system, can island from the local utility grid and function as a stand-alone system". This study found that DoD installation microgrids were generally categorized under 4 main categories:

1. Backup generators, not grid-tied (building generators)
2. Backup generators, grid-tie
3. Low RE penetration (PV): generators + PV, grid-tie
4. High RE penetration (PV): generators + PV + battery, grid-tie

Figure 1. DoD installation microgrid overview



There are no existing commercial military microgrids, since existing systems are either demonstration research projects, or have been developed through multiple integration efforts over many years. Current microgrid projects have been expensive (>$10M). Figure 1 shows that the majority of DoD microgrids are standby diesel generators, and there is a small degree of renewable energy penetration in microgrid designs. Advanced microgrids that integrate renewable energy, advanced controls, and batteries continue to be expensive, and, therefore, demonstration projects. As microgrid complexity increases, so do their capital, operations, maintenance, and security-related costs.

A follow-on study commissioned by DoD with MIT-LL in 2016[2] found that there were cost-effective opportunities for larger, centralized backup generator microgrids. These microgrids fall under category 2, and allow for a portion of the distribution system servicing critical loads to be in islanded mode during grid disruptions. The study also found that before implementing any microgrid solution, the distribution system near the critical loads must be reliable enough to receive it. Larger, centralized backup generators are a more cost-effective, near-term approach because they optimize critical mission loads (not the entire base load), can incorporate cost-effective/targeted RE (solar) and batteries (UPS), target right-sized systems and controls for critical energy loads, allow for easier management of security-related risks and costs, and align to the capabilities of existing personnel in government or industry. The study found that prioritizing energy when and where it is needed to meet mission requirements of a base when disruptions occur (resilience) can be achieved cost-effectively. It also found that decisions must be viewed principally through the lens of mission requirements in order to maximize the potential of available, reliable, and quality energy sources and systems in a cost-effective manner.

[1] https://ll.mit.edu/mission/engineering/Publications/TR-1164.pdf
[2] https://ll.mit.edu/mission/engineering/Publications/TR-1216.pdf

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