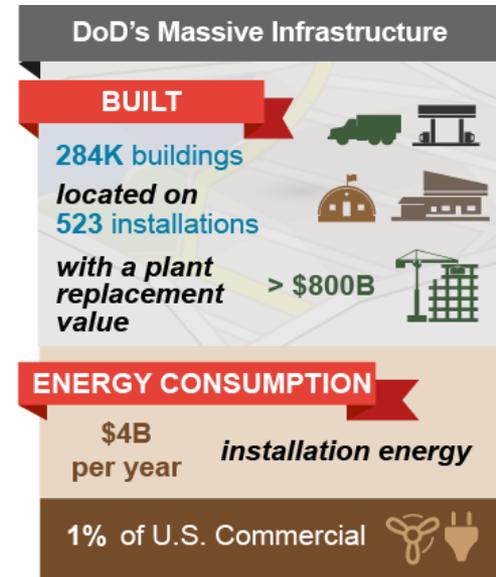


# Power Begins at Home: Assured Energy for U.S. Military Bases



# DoD Energy Security: Challenge & Threats

- Military bases are dependent on the commercial grid
  - Power projection
  - Command, control & data centers
  - Testing, training & education
  - Hospitals & safety
  - Housing & administration
  - R&D & industrial



## ■ The electric grid is vulnerable

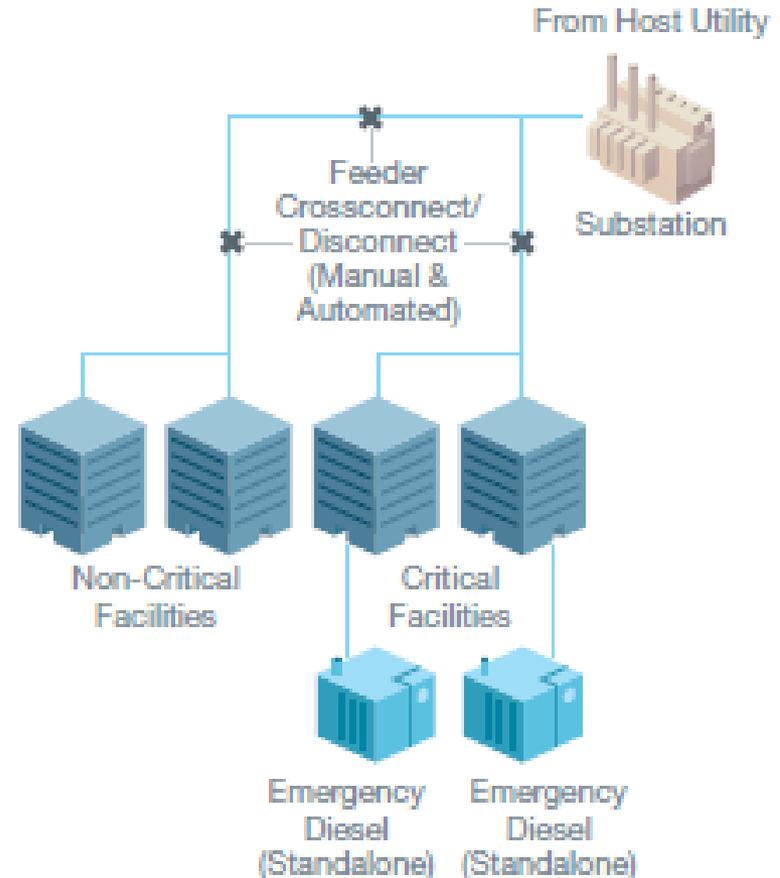
- Military bases experience outages today - multi-day outages occur
- A growing threat
  - Natural disasters and extreme weather
  - Physical threats
  - Cyber threats

## Admiral Michael S. Rogers

“...it is only a matter of when, not... if, you are going to see a nation state, a group, or actor engage in destructive behavior against critical infrastructure of the United States. On the 23<sup>rd</sup> of December ... an actor penetrated the Ukrainian power grid and brought large segments of it offline in a very well-crafted attack. That isn't the last we are going to see of this.”

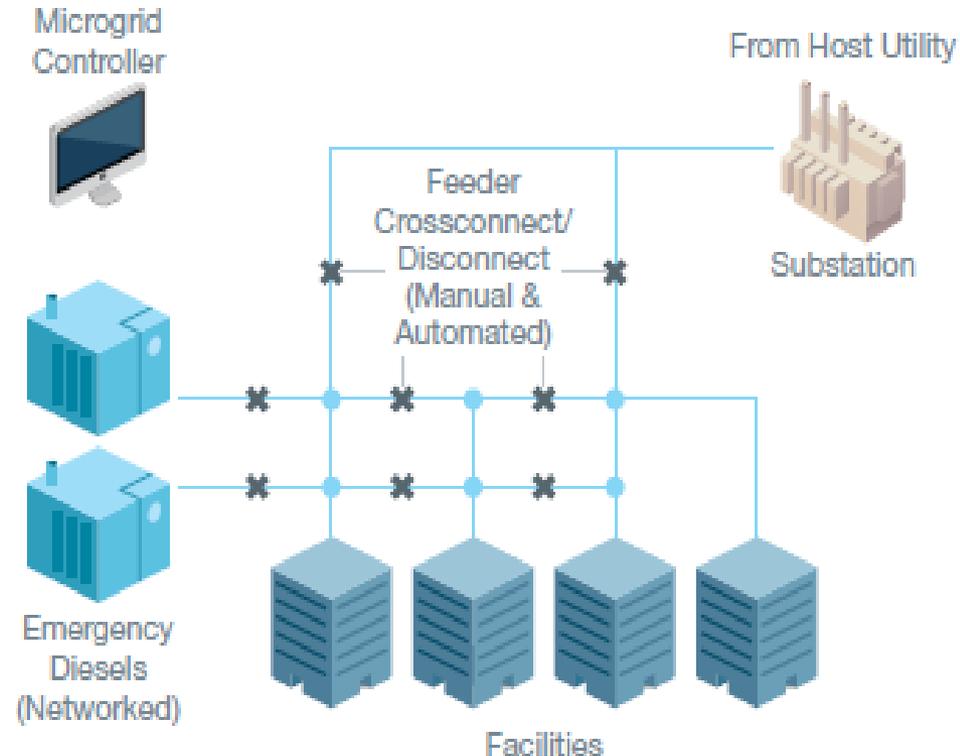
# Standalone Generators: Today's Approach

- Hard-wired directly to individual buildings with critical loads
- Diverse and numerous
  - Dozen of brands
  - Multiple sizes
    - 50 kW to 1,000 kW
  - Typically 100 to 200
  - Procured independently
    - Multiple sources of funding
- Solely of value during an outage



# Microgrids: A Resilient Solution

- Operates either in parallel to the grid or in island mode
  - provide emergency backup power
  - a source of revenue and savings
- Today
  - Dozens of commercial microgrids
  - Federal microgrids
    - FDA White Oak campus
    - MCAS Twentynine Palms
    - Miramar NAS
  - Investments for the future
    - Ft. Drum
    - Schofield
    - On-site Renewable energy



# Technical Performance

Criteria	Standalone	Microgrid
Efficient Sizing	<ul style="list-style-type: none"> <li>▪ Oversized by design (2x)                             <ul style="list-style-type: none"> <li>• As executed often worse</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Optimal sizing                             <ul style="list-style-type: none"> <li>• Non-coincident peak power</li> </ul> </li> </ul>
Maintenance	<ul style="list-style-type: none"> <li>▪ Large O&amp;M costs                             <ul style="list-style-type: none"> <li>• Many poorly maintained</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Less expensive to maintain                             <ul style="list-style-type: none"> <li>• Relies on a small number of standardized generation units</li> </ul> </li> </ul>
Reliability	<ul style="list-style-type: none"> <li>▪ Often poor due to inadequate maintenance                             <ul style="list-style-type: none"> <li>▪ N+X is rare and expensive</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Readily provides a high level of reliability (N+1 or N+2)                             <ul style="list-style-type: none"> <li>▪ Networked structure makes it cost effective</li> </ul> </li> </ul>
Flexibility	<ul style="list-style-type: none"> <li>▪ No ability to meet changing requirements                             <ul style="list-style-type: none"> <li>▪ Established at purchase</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Can respond to changes in electricity needs                             <ul style="list-style-type: none"> <li>• At no additional costs</li> </ul> </li> </ul>
Coverage	<ul style="list-style-type: none"> <li>▪ Forces all or nothing solution                             <ul style="list-style-type: none"> <li>• Needs are nuanced</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Excess generation capacity can serve                             <ul style="list-style-type: none"> <li>• Intermediate loads can be supported</li> </ul> </li> </ul>

# Economic Modeling

- A realistic but hypothetical large military installation

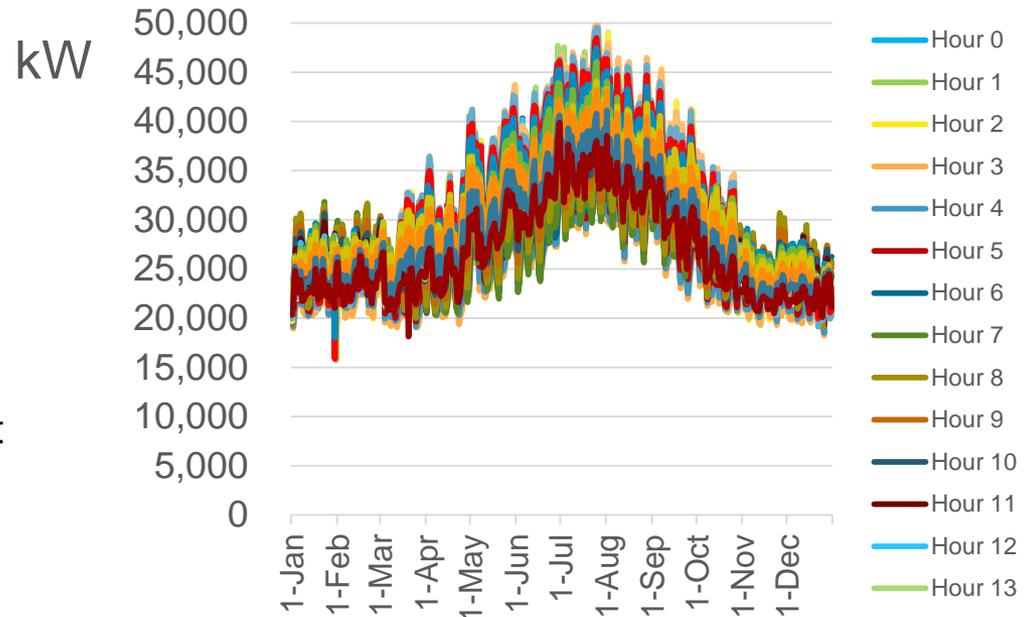
- Peak demand of 50 MW
- 20 MW is deemed critical
- Three locations
  - California
  - Mid-Atlantic
  - Southeast

- Comprehensive measure of (net) cost

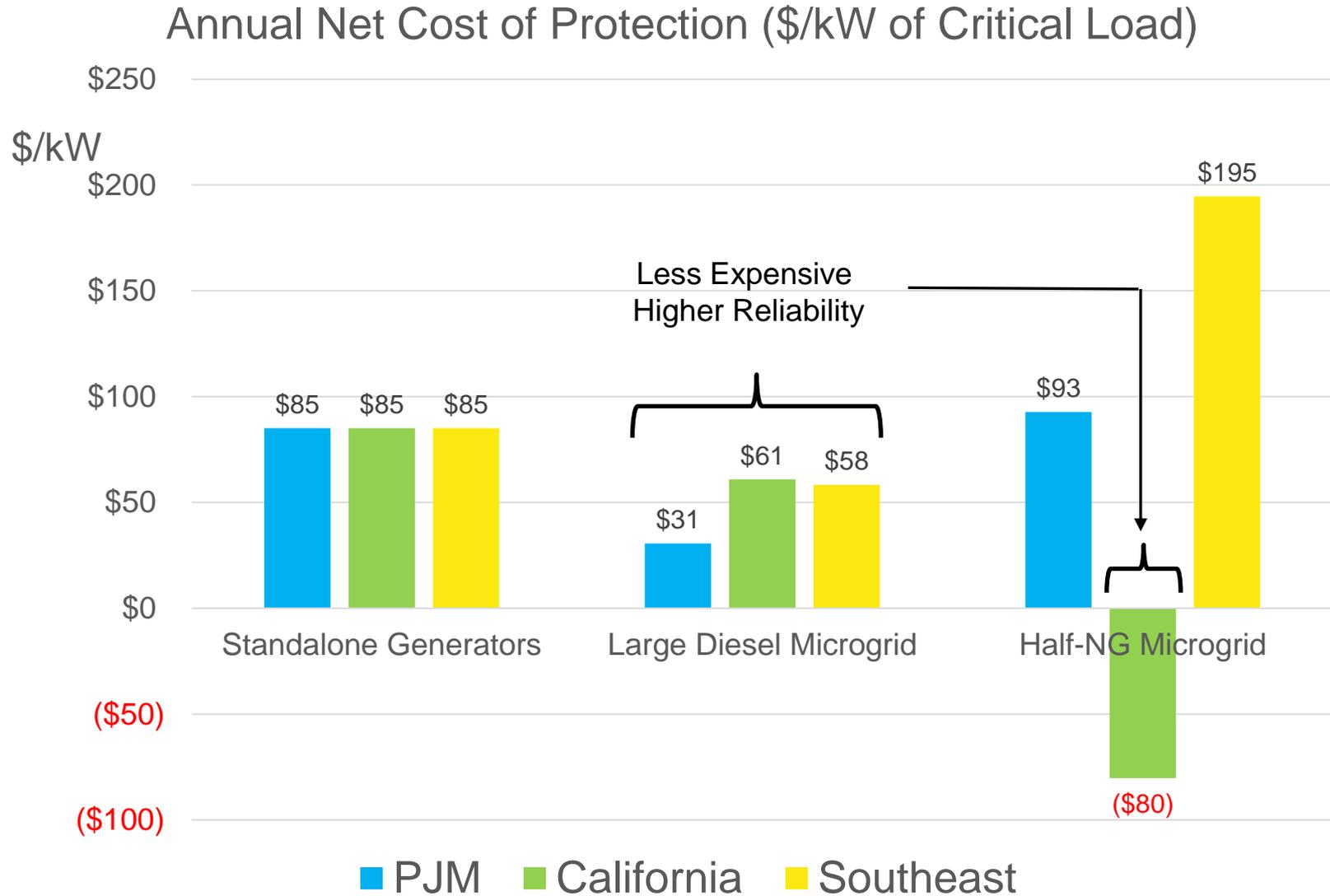
- 20 year life cycle
- Regional energy prices
- Potential revenue
  - peak shaving
  - participation in energy markets

- Analyzed at an hourly level

- Roiled up to a single metric - \$/kW of critical load protected



# DoD Energy Security: Economic Results



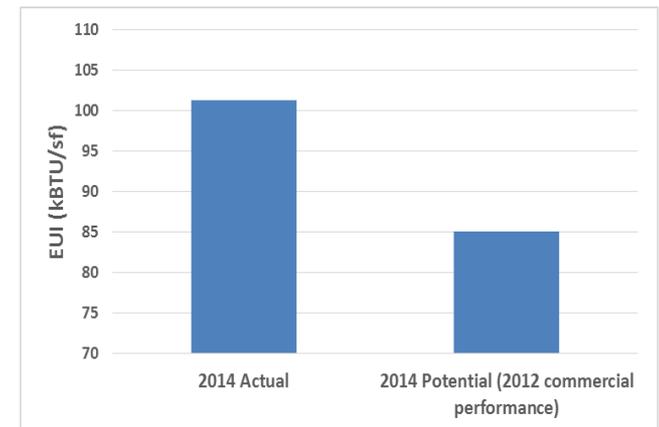
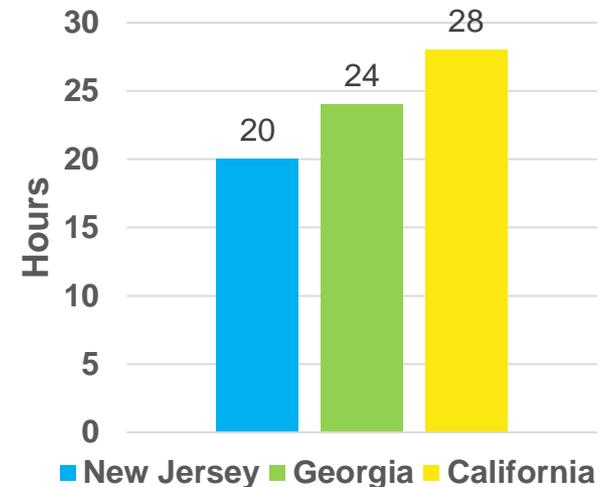
# Microgrid Implementation

- DoD should procure energy security as a service
  - Microgrids are not unique to the military
  - Power markets are volatile
  - Microgrid management is complex
  - Optimal solutions require incentives that link design, construction, and operations
  
- Third party financing is feasible
  - Sufficient savings to support implementation through an ESPC or UESC
    - Must recognize and account for the current costs of energy security (standalone generators)
  
- DoD must be able to define, articulate and quantify its performance requirements

# Renewables & Efficiency

- Role of Renewable energy
  - On-site renewable energy can enhance the energy security of a military installation
    - PV can extend islanding duration and scale of backup power
  - Today solar and wind power cannot serve as the primary backup power for mission critical needs
    - Storage costs are still high
- Energy efficiency and energy security are inextricably linked
  - A kW saved requires no backup
  - DoD is leaving ~ \$1B/year of energy savings on the table
    - And securing ~ 25% higher energy loads
- Meeting DoD's Efficiency Potential
  - Requires metering DoD buildings
  - Linking capital improvements and energy savings investments

Extended Protection of Critical Loads with Properly-Configured & Located 5 MWac PV



# Value of Energy Security

- Should DoD put a value on energy security?
  - It already does – the full costs of standalone generators
    - Which can be lowered
  - DoD should not pay a premium
  
- How much energy security should DoD buy?
  - Backup power for critical military functions is required
    - Mission critical
    - Health life and safety
  - Backup power for “intermediate loads” is a business decision
    - Benefits for DoD of backup power far outweigh their costs over 20 years
    - From a business standpoint, DoD is currently underinsuring many non-critical loads on its military bases