Military Microgrids

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Types of Military Microgrids

Expeditionary Microgrids

Forward Operating Base Microgrids

Installation Microgrids

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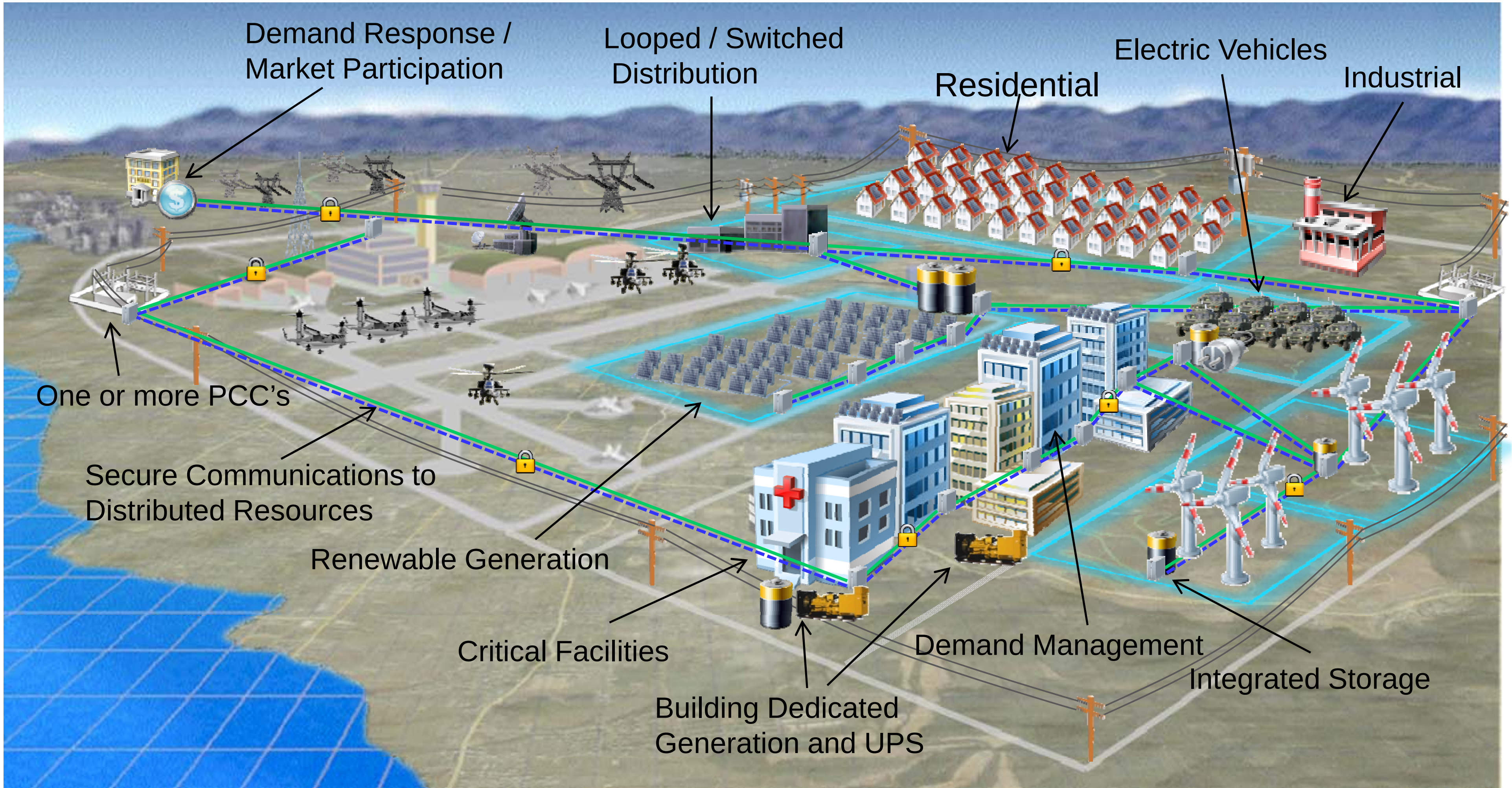
Anatomy of Installation Microgrids



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DoD Installation Energy Challenges

Challenge

- **Generation Dependency**
  - Distant
  - Beyond scope of control
  - Vulnerable

- **Distribution Dependency**
  - Local, regulated utility (monopoly)
  - Are priorities aligned with those of DoD installation?

- **Cost of Power**
  - Demand Charges (tiered)
  - Consumption Charges

- Secondary Challenges:
  - Renewable Energy Mandates
  - Efficiency Targets
  - Carbon Accounting

Traditional Solution

- Dedicated Backup Generators
  - Reduces down-time, but at unnecessary, increased expense (CAPEX *and* OPEX)
  - Introduces inefficiencies
    - Must over-size gensets
    - Genset design tradeoffs
    - Sub-optimal performance band
  - Minimal options for island duration or priority-setting

- Passive efficiency initiatives

Microgrid Solution

- Redundancy
  - No single point of failure – gensets networked across critical loads
- Incorporates existing gensets / equipment
- Efficiency: use generators at optimal point on performance & cost curve
- Complete or partial installation island capability
- Controls manage power stability and quality
- Load prioritization flexibility
- Integrates with on-site renewable generation and storage
- Building Management System interface for fine grain load control
- Optimization for economics during normal operations leveraging full set of resources

Top 10 Requirements

1. Operate islanded or in parallel with utility grid
2. Provide reliable and stable power when islanded
3. Critical loads must be served
4. Integrate existing elements and support addition of new elements, including backup generators, renewable generation, energy storage, EV's, building automation, and fault tolerant distribution
5. Improve reliability of existing elements
6. Resilient to cyber and physical attack
7. Optimization when islanded to conserve fuel / maximize longevity
8. Tiered load management
9. Leverage resources for cost savings during normal operations
10. Support the local utility grid during normal and emergency operations (regulation, spinning reserve, black start)

Implementation Challenges

- **Energy Surety Affordability**
  - ROI model for Energy Surety does not yet exist
  - Can leverage resources for economic gain to improve affordability
- **Renewable Generation Installation**
  - In many cases, connected to utility/transmission grid and not to installation electrical infrastructure. Costly to integrate into microgrid
  - Typically funded through Power Purchase Agreement, which does not allow controls integration. Objective is to produce as much power as possible versus grid stability
- **Stability when Operating Independent of Utility Grid**
  - Low Inertia or Microgrid requires separate protection studies / settings and fast acting controls,
- **Demand Side Optimization**
  - Microgrid integration may conflict with Energy Savings Performance Contracts (ESPC) already in place
- **Integration with Local Utility**
  - Must work closely with local utility to ensure islanding/reconnect does not cause stability issues for either installation or utility grids

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