Microgrids and DoD Facilities

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SERDP
DOD ▪ EPA ▪ DOE

ESTCP

DoD's Environmental & Energy Technology Programs

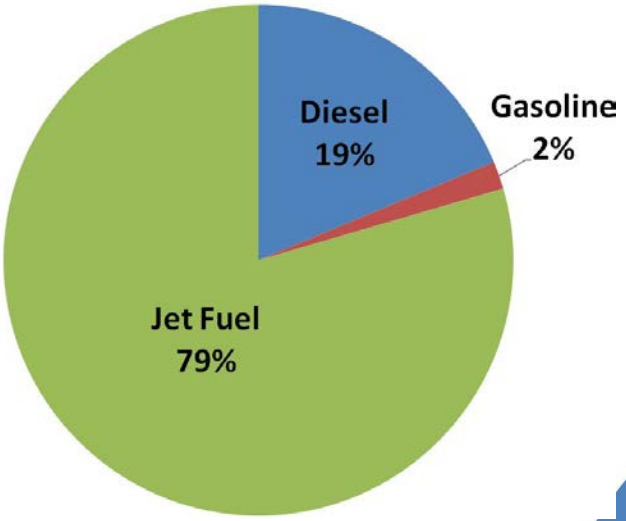
Science and Technology

- DoD, DOE, EPA Partnership
  - Advanced technology development to address near-term needs
  - Fundamental research to impact real world environmental management

Demonstration/Validation

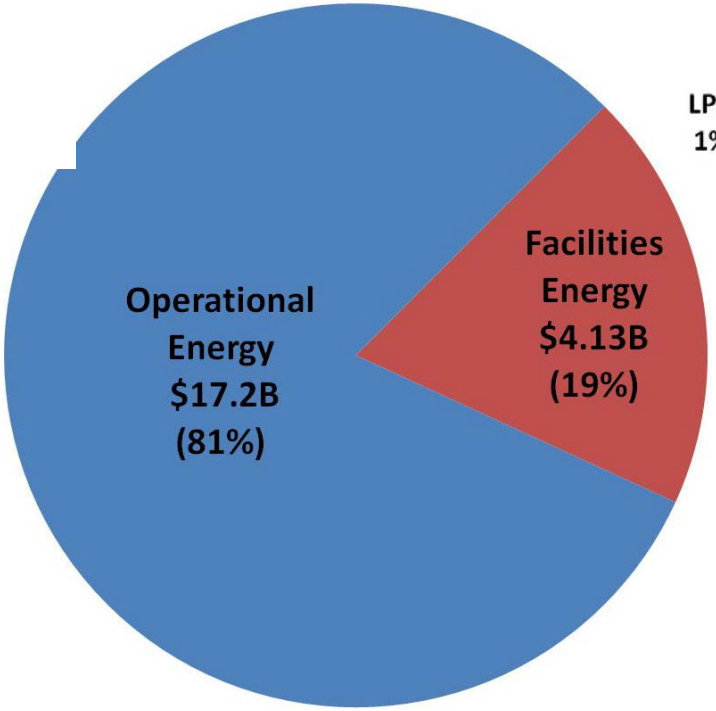
- Demonstrate Innovative Cost-Effective Environmental and Energy Technologies
- Promote Implementation
  - Direct Technology Insertion
  - Partner with End User and Regulator

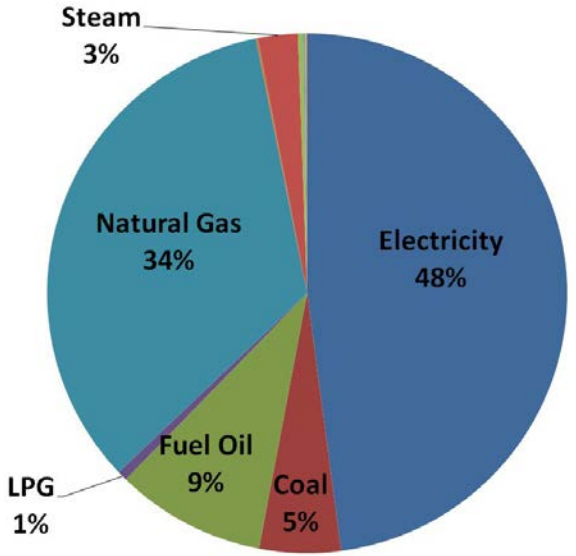
DoD Energy Costs



Operational

DoD Energy Costs
FY11: $21.3B
FY10: $15.2B





Installations

* $4.13B in Facility energy costs include non-tactical vehicle fuel
$3.85B – Facility energy
$0.27B – non-tactical vehicle fuel

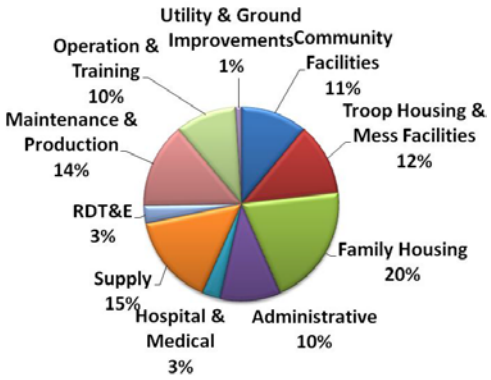
Why Facility Energy Matters

- Significant Cost
  - FY11: $4.1 billion
  - Cost likely to increase as troops return
  - Contributes a disproportion share (~ 40%) of GHGs
- Mission Assurance
  - DoD's reliance on a fragile commercial electricity grid places continuity of critical missions at serious and growing risk [1]
- Statutory and regulatory goals for energy intensity, renewable energy and GHGs

[1] Defense Science Board, "More Fight – Less Fuel," February 2008

DoD's Built Infrastructure

DoD Building Stock



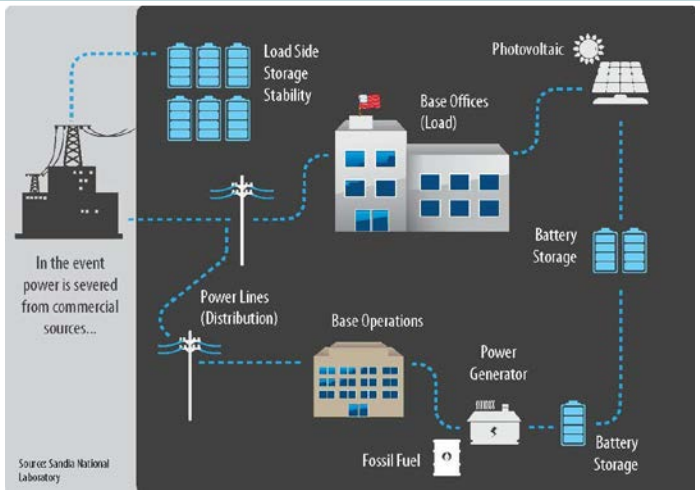
- 539,000 Facilities (buildings and structures)
  - 307,295 buildings
    - 2.2 billion square feet
- Comparisons
  - GSA: 1,500 government buildings
    - 176 million square feet
  - Wal-Mart US: 4,200 buildings
    - 687 million square feet
- 160,000 Fleet Vehicles

Facility Energy Core Strategy

Reduce Demand

Expand Supply

Enhance Security



Leverage Advanced Technology

Installation Energy Security

- DoD Facilities Are a Large Consumer of Electricity
  - ~ 30B KWhr electricity in 2010 worldwide
  - US installations peak power range from ~10MW to over 100MW
  - DoD installations are in most electricity markets
  - DoD Installations often do not look like commercial facilities
    - Power profiles and security concerns

- Changing Market Offer DoD Installations Opportunities
  - New revenue streams

- DoD Drivers
  - Economics
  - Energy security

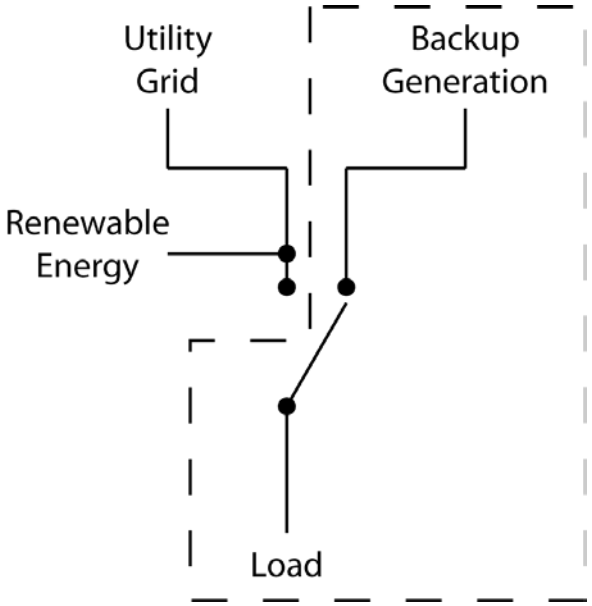
Smart Microgrids

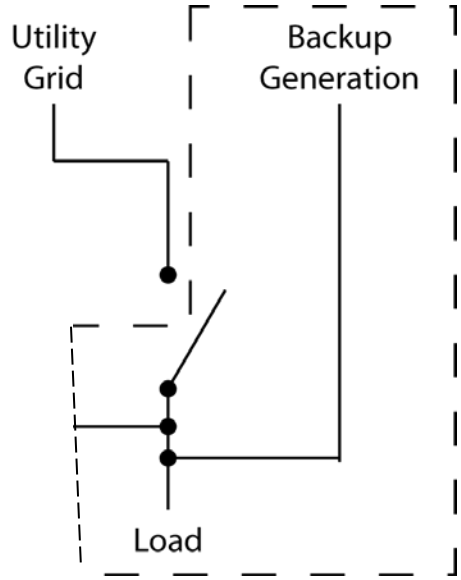
DoD and Microgrids

Primary goal of DoD installation microgrids is to provide energy security in a cost effective manner.

- Must include an interconnected set of loads and generation resources
- Implies the ability to disconnect from the main grid and operate in an islanded mode
- Choice of generation resources depends on the individual base
  - Centralized power generation in conjunction with the local utility
  - Distributed generation (DG) using existing assets on base
  - Renewable generation
- Economics depends strongly on the microgrid's ability to operate in parallel with the larger electric grid and the local utility market

Traditional Microgrids





Cannot operate in parallel with larger grid

Traditional energy security. Only "revenue" is avoided costs from grid outages

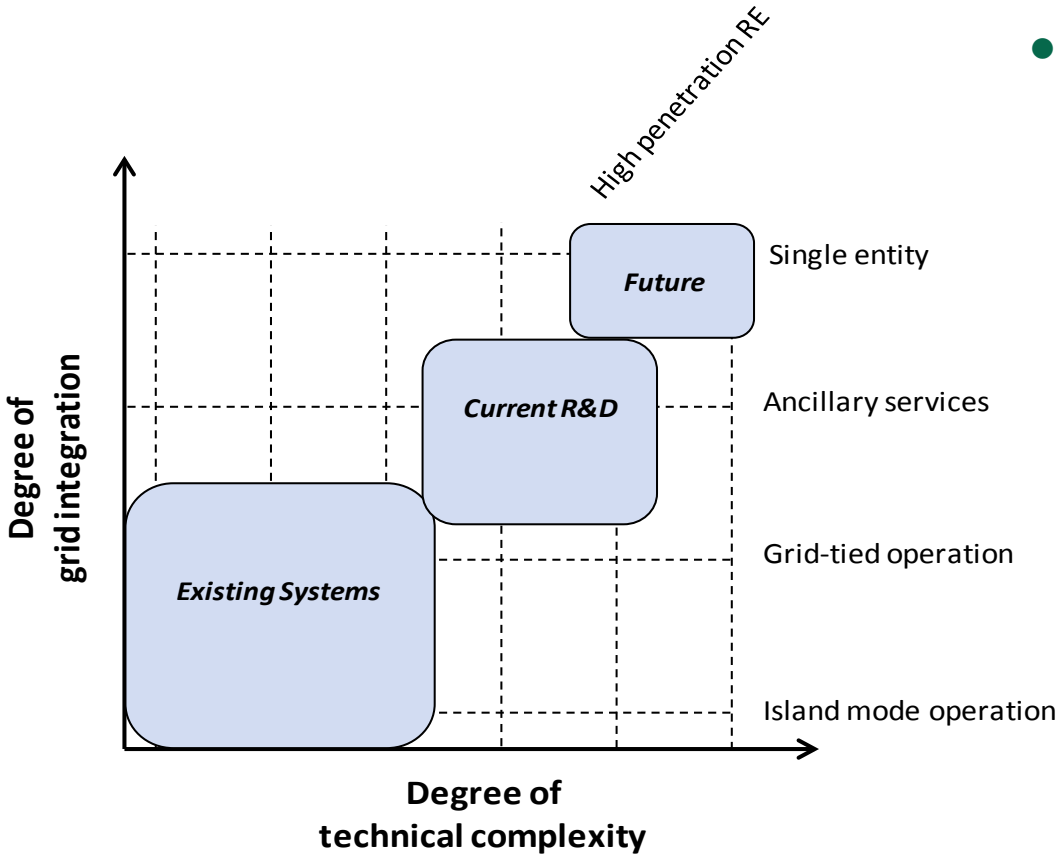
Ex. Offut, Mcconnell, Kunsan

Generation resources can synchronize and operate in a parallel fashion with the utility grid or in an islanded mode – limited automation

Energy security and simple DR

Ex. Dahlgren, Ft. Detrick, Tinker

Microgrid Path



- Key challenges
  - Networking multiple generators
  - Introduction of renewable generation
    - higher penetrations potentially provides the greatest benefit
  - Faster system response
  - Seamless integration
  - Cybersecurity

ESTCP Installation Energy Test Bed

- Use DoD Facilities As Test Bed For Innovative Energy Technologies
  - Validate performance, cost, and environmental impacts
  - Transfer lessons learned, design and procurement information across all Services and installations
  - Directly reach out to private sector for innovations
  - Directly leverage DOE investments
- Develop, Test & Evaluate For All DoD Facilities
  - Energy Conservation & Efficiency
  - Renewable and Distributed Energy Generation
  - Control & Management of Energy Resources & Loads

Reduce Energy Costs - Improve Energy Security

Installation Energy Roadmap

Smart Secure Installation
Energy Management
- Micro-grids
- Energy Storage
- Ancillary Service Markets

Efficient Integrated Buildings
- Design, Retrofit, Operate
- Enterprise Optimized Investment
- Advanced Components
- Intelligent Building Management

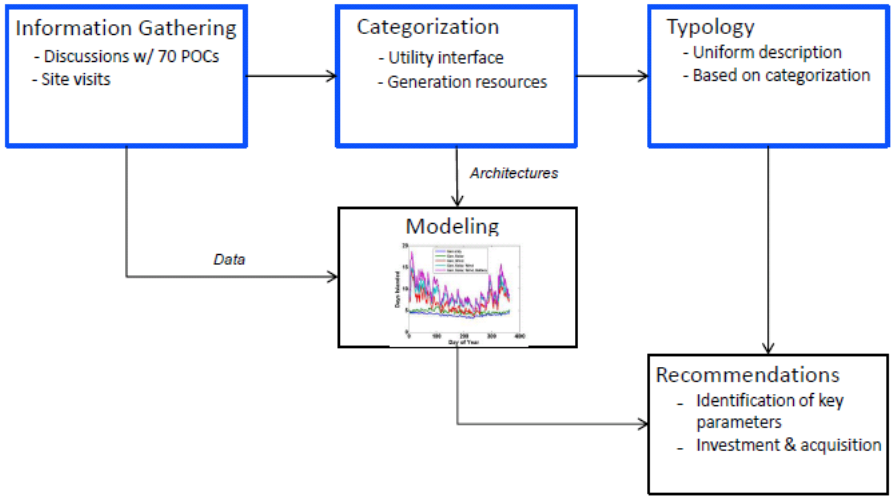
On-Site Energy Generation
- Cost Effective Renewables
- Waste to Energy
- Geothermal
- Building Integrated Opportunities

Smart Secure Installation Energy Management

- Micro-grids, Energy Storage & Ancillary Service Markets
  - ♦ Four active demonstration projects
    - Lead Organizations: GE (2), UTRC and Lockheed Martin
      - – 29 Palms, Ft. Bliss, McGuire AFB
  - ♦ FY 2012 : 6 new demonstration projects
    - Lead Organizations: Eaton, GE, Satcon, Raytheon, LBNL, Honeywell
      - – 29 palms, Ft. Bliss, Ft. Detrick, Ft. Irwin, MCAS Miramar, LA AFB, Ft. Sill
    - Four different energy storage approaches
    - Two ancillary services demonstrations
  - ♦ Additional demonstrations planned FY 2013

MIT/LL Study

- Develop a typology
  - Categorize and describe DoD micro-grid efforts
  - Functional goals, approach, level of maturity,
- Identify common, measurable parameters for assessing micro-grid systems on fixed installations
  - Financial performance, energy security, contribution to DoD renewable energy goals
- Perform first order cost-benefit trades for different architectures in order to help guide future development efforts



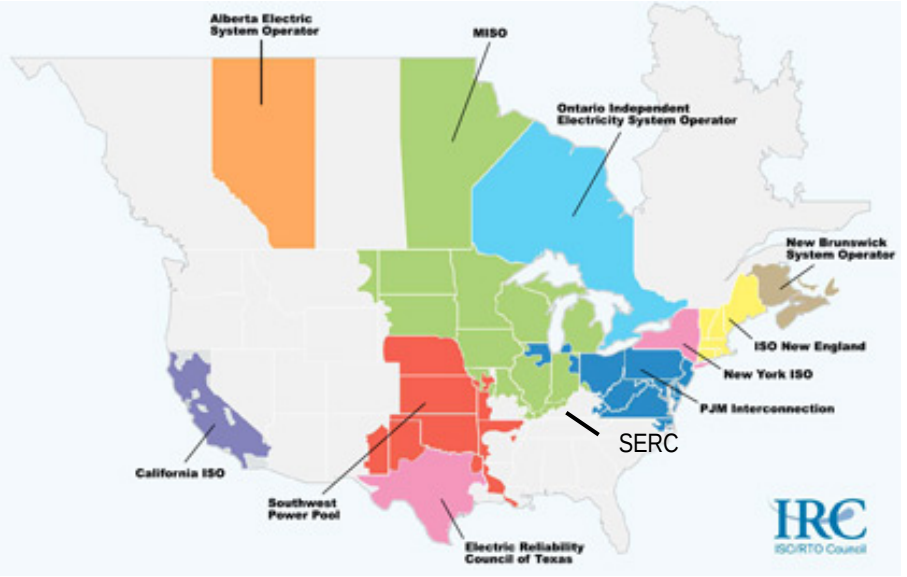
BENS Study

- Business Executives for National Security (BENS) Study: Evaluating the Potential for Micro-grids in DoD
  - Study Objectives:
    - Analyze the use of micro-grids at domestic Department of Defense (DoD) military installations
    - Define and assess alternative business models
      - alternative operating models for the ownership, operations, financing, revenue generation, & economics
    - Develop criteria for the size and scope
      - include both the supply of electric power the demand for power and the efficiency of existing assets
    - Assess the non-technical challenges and impediments to broad micro-grid deployment

ICF Study

Focus: Financial Optimization of Electricity Security Assets

- Assess
  - Electricity use
  - Infrastructure
  - Regional market opportunities



- Three Installations
  - Analyze the financial and environmental benefits of five electricity technologies
  - Identify technical and institutional barriers
  - PJM, CA-ISO and Southern Company sub region of SERC

Microgrid Benefits

- Increased reliability at a lower overall cost
  - Networking of sources allows fewer generators
- Greater efficiency, which can lead to lower costs
  - Networking generation assets allows for load sharing
- Enabler for the integration of renewable generation
  - Provides increased energy security
- Ability to generate cost savings by using backup generation assets during normal operation
  - demand-response program and peak-shaving,
- Ability to generate financial gain by exploiting advanced ancillary services
  - Opportunity for energy storage devices or aggregated loads

Web site

www.serdp-estcp.org