Innovation and Installation Energy

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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
  - Transition technology out of the lab
  - Create Partnerships and Test at DoD Facilities
  - Gain end user and regulator acceptance
Environmental Drivers

Reduction of Current and Future Liability

Contamination from Past Practices

- Groundwater, Soils and Sediments
- Large UXO Liability
- Emerging Contaminants

Pollution Prevention to Control Life Cycle Costs

- Elimination of Pollutants and Hazardous Materials in Manufacturing Maintenance and Operations
- Achieve Compliance Through Pollution Prevention
Environmental & Energy Drivers

Sustainability of Ranges, Facilities, and Operations

Maritime Sustainability
Threatened and Endangered Species

Installation Energy

UXO & Munitions Constituents

Toxic Air Emissions and Dust

Noise

Climate Change

Change in Temperature (°C) for (2040-2070) minus (1960-1990) : (DJF)
Program Areas

Weapons Systems & Platforms

Environmental Restoration

Energy & Water

Resource Conservation & Climate Change

Munitions Response
Drivers for DoD Environmental & Energy RDT&E

- Needs
  - Unique military requirements
  - Mission critical
  - Regulatory
    - EPA, States, DOI, EO ....
  - Economics
  - Policy

- Opportunities
  - DoD’s Unique position
    - Natural and built infrastructure
  - DoD’s unique culture
  - DoD’s market size
DoD Energy Costs

FY11: $19.4B
(FY10: $15.2B)

* $4.12B in facilities energy costs include non-tactical vehicle fuel
$3.85B – facilities energy
$0.27B – non-tactical vehicle fuel
Why Facilities Energy Matters

- **Significant Cost**
  - FY11: $4.1 billion
  - Cost likely to increase (reduced presence in Iraq and Afghanistan)

- **Environmental Impact**
  - Contributes a disproportion share (~ 40%) of GHGs

- **Mission Assurance/Energy Security**
  - DoD’s reliance on a fragile commercial electricity grid places continuity of critical missions at serious and growing risk
Key Energy Goals

• Legislation and Executive Orders
  – EPAct 2005, EISA 2007, NDAA
  – EO 13423, EO 13514

• Key Targets
  – Facility Energy Efficiency
    ▪ Reduce facilities energy intensity by 30% by 2015 and 37.5% by 2020 (2003 baseline)
  – Renewable Energy
    ▪ Produce or procure 25% of facilities energy from renewable sources by 2025
  – Water
    ▪ Reduce potable water intensity by 26% from a 2007 baseline by 2020
  – Non-Tactical Fleet Petroleum Fuel Consumption Reduction
    ▪ Reduce non-tactical fleet fuel consumption by 30% by 2020 (2005 baseline)
Energy Intensity Reduction: 13.3% (FY11 Goal: 18%)

Water Intensity Reduction: 10.7% (FY11 Goal: 8%)

NTV Petroleum Reduction: 11.8% (FY11 Goal: 12%)

10 USC 2911e RE: 8.5% (FY11 Goal: 11%)
Facilities Energy Strategy

Reduce Demand

Expand Supply

Enhance Security

Advance New Technology

Installation Energy Test Bed: 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 Generation
  - Cost Effective Renewables
  - Waste to Energy
  - Building Integrated Opportunities
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
Why The Test Bed Is Needed

- Emerging technologies hold the promise of dramatic improvements in installation energy performance but face major impediments to commercialization and deployment ("Valley of Death")
  - Highly cost-sensitive market inhibits introduction of new technology
    - Energy is a cost of doing business and thus rarely the prime mission of an enterprise
      - technologies do not usually provide the end customer with a new capability unlike IT or biotech
      - costs are sensitive to the operational efficiency, maintenance, and the lifetime of the component
  - "Split incentives" or "Principal agent" problem
    - entity that bears the up-front capital costs is not the same as the one that reaps the savings
  - No incentive for first use
    - significantly more risk and highly fragmented market
  - Lack of information results in high transactional costs and an inability to properly project future savings
    - return on the capital investment is often in terms of avoided future costs and integrated performance
  - Lack of operational testing inhibits commercialization and deters potential adopters
    - conditions such as building operations, variable loads, human interactions
  - A&E firms face liabilities but do not share in savings
    - prefer reliability over innovation
DoD Built Infrastructure

- **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**
DoD Built Infrastructure

Investments

♦ Military construction
  ▪ ~ $12 B

♦ Sustainment
  ▪ ~ $8 B

♦ Recapitalization
  ▪ ~ $9 B

♦ ~$1B of this is energy conservation

♦ Plus ~ $1B of private financing for energy conservation
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
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 Micro-Grids
Military Installations and Energy Markets

Military installations: http://tigerline.census.gov/cgi-bin/shapefiles2009/national-files
California Military Installations and Electricity Markets

Balancing Authorities (10)

- California Independent System Operator (CAISO)
- Los Angeles Department of Water & Power (LADWP)
- Balancing Authority of Northern California (BANC)
- Imperial Irrigation District (IID)
- Turlock Irrigation District (TID)
- PacifiCorp-West
- Bonneville Power Administration (BPA)
- Sierra Pacific Power (SPP)
- Nevada Power Co.
- Western Area Lower Colorado (WALC)

Utility Companies (57)

- Area served by both Surprise Valley Electric Co-Op & PacifiCorp
- Area served by both Lassen & Plumas-Sierra
- Plumas-Sierra
- Truckee-Donner
- Liberty Energy
- Kirkwood Meadows
- Valley Electric
- LADWP
- Port of Stockton
- Area is served by both MUD & PGE
- Victorville
- Aha Macau
- Rancho Cucamonga
- Co
- Loomis
- Glendora
- Burbank
- Vernon
- Industry
- Moreno Valley
- SDG&E
- IID

CA information: http://www.energy.ca.gov/maps/
Military Installations Often Do Not Look Like Commercial Facilities

**MIT Lincoln Laboratory**
- Mean = 9.0 MW
- Peak = 13.5 MW
- Offices and laboratories, low weekend usage.
- Significant monthly variations due to weather

**Navy Base San Diego**
- Mean = 36.4 MW
- Peak = 58.8 MW
- Living quarters as well as working, less daily variation
- Presence of ships affects energy demand

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**Demand Data - Examples**

- **MIT LL**
  - Offices and laboratories, low weekend usage.
  - Significant monthly variations due to weather

- **NBSD**
  - Living quarters as well as working, less daily variation
  - Presence of ships affects energy demand

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**Military Installations Often Do Not Look Like Commercial Facilities**
Smart Secure Installation Energy Management

Smart Microgrid at 29 Palms

Lockheed Martin Microgrid at Ft. Bliss

Sodium-Metal-Halide Battery Energy Storage System at 29 Palms

Zinc Bromide Flow Battery at MCAS Miramar
Energy Efficient Integrated Buildings

optimized investments - advanced components - intelligent building management

Diagram:
- Concept & Design: Hand off to A & E Firms
- Build: Hand off to Contractors
- Operations & Maintenance: Hand off to Property Managers & Operations Staff

Barriers:
- Scalability
- Robustness
- Productivity

Low Energy Savings Potential
- Unaware
- Unapproachable analysis tools

As-built variances from specifications
- Miss

Poor operation or maintenance
- Loss
Efficient Integrated Buildings

Electrochromatic Windows

Continuous Building Commissioning

Systems Approach to High Performance Buildings

Drive-By Thermal Imaging
On-Site Generation

- BIPV Roofs
- Low-BTU Landfill Gas Microturbine
- Grid Parity Solar Power
- Solar Air Heated Roofs
ESTCP Demonstrations

- Technologies are sought that can significantly benefit from a demonstration on a DoD installation

- Priority is given to technologies for which a demonstration on a DoD facility is required to:
  - assess the cost and performance of the technology
  - provide information that will accelerate commercialization and broader adoption
ESTCP FY 2013 Solicitation

1. Smart Secure Integrated Installation Energy Management
2. Cost Effective On-Site Distributed Generation
3. Advanced Component Technologies to Improve Building Energy Efficiency
4. Advanced Building Energy Management and Control
5. Tools and Processes for Decision-making Associated with Energy Use and Management
6. Advanced Water Management and Controls for DoD Buildings

http://serdp-estcp.org/Funding-Opportunities/ESTCP-Solicitations/Installation-Energy-Solicitation
Web site

www.serdp-estcp.org
Installation Energy Topics FY13

1. Smart Secure Integrated Installation Energy Management

- Innovative approaches to improve the security of an installation’s overall energy management, decrease costs, and provide new revenue streams
- Technologies that enable the implementation and management of smart micro-grids on Department of Defense (DoD) installations to meet DoD energy security goals
- Micro-grid demonstrations should involve the integration of new or existing combinations of controls, generation sources and storage among clusters of buildings
- Demonstrations are also of interest which enable participation in the advanced demand response and ancillary services markets and the integration of innovative electric vehicle infrastructure solutions.
Installation Energy Topics FY13

2. Cost Effective On-Site Distributed Generation

- Innovative technologies to increase distributed and renewable energy generation on DoD installations to meet DoD energy goals.

- Demonstrated technologies must show a levelized cost of electricity that reflects grid parity for the proposed application or a clear pathway to grid parity when mature.

- Renewable technologies of interest include, but are not restricted to:
  - Solar & Geothermal
  - Waste-to-Energy & Biomass
    - biomass and waste-to-energy systems should be economically efficient without import of off-installation resources.

- Renewable technologies involving hydroelectric, offshore wind or liquid biofuels for transportation will not be considered under this solicitation.
Installation Energy Topics FY13

3. Advanced Component Technologies to Improve Building Energy Efficiency

♦ Cost effective component technologies to increase energy efficiency in DoD buildings to meet DoD energy goals
  ▪ innovative technologies appropriate for building retrofits

♦ Technologies of interest include, but are not restricted to:
  ▪ Heating
  ▪ Ventilation and air conditioning
  ▪ Building envelope technologies
  ▪ Lighting and waste heat recovery (for heating or cooling)

♦ Integrated demonstrations of combinations of technologies are also of interest, including building integrated renewable energy systems
4. Advanced Building Energy Management and Control

- Innovative cost-effective technologies or combinations of technologies to meet energy goals by increasing the performance of DoD buildings
  - Desired energy use reductions occur through increased efficiency in commissioning, diagnostics, and operations.
- Technologies of interest may also improve:
  - Advanced metering or sub-metering
  - Increase the quality and reliability of building performance data
  - Ensure compliance with DoD communications and information assurance requirements
Installation Energy Topics FY13

5. Tools and Processes for Decision-making Associated with Energy Use and Management

- Innovative technologies to provide individual energy users, building managers, facility managers, regional managers and/or DoD portfolio and enterprise managers the right amount of information at the right time to make appropriate decisions related to energy usage and investments.

- Tools to provide energy managers, particularly at military installations, with the ability to evaluate the business case for energy infrastructure retrofits and new investments, exploit advanced metering systems, measure and validate energy performance and visualize trends.

- Holistic management tools that address energy, waste and water on military installations are also appropriate for demonstration.
Installation Energy and Water Topic FY13

6. Advanced Water Management and Controls for DoD Buildings

♦ Water management technologies and processes that will reduce water loss and increase the efficient usage of available water

♦ Technologies that improve water usage in buildings or clusters of buildings by addressing:
  ▪ Water conservation
  ▪ Leak detection and repair
  ▪ Greywater reuse
  ▪ Rainwater harvesting
  ▪ Energy associated with water management.

♦ Tools and processes that enable managers to identify, implement and measure the impact of water savings and reuse technologies and practices