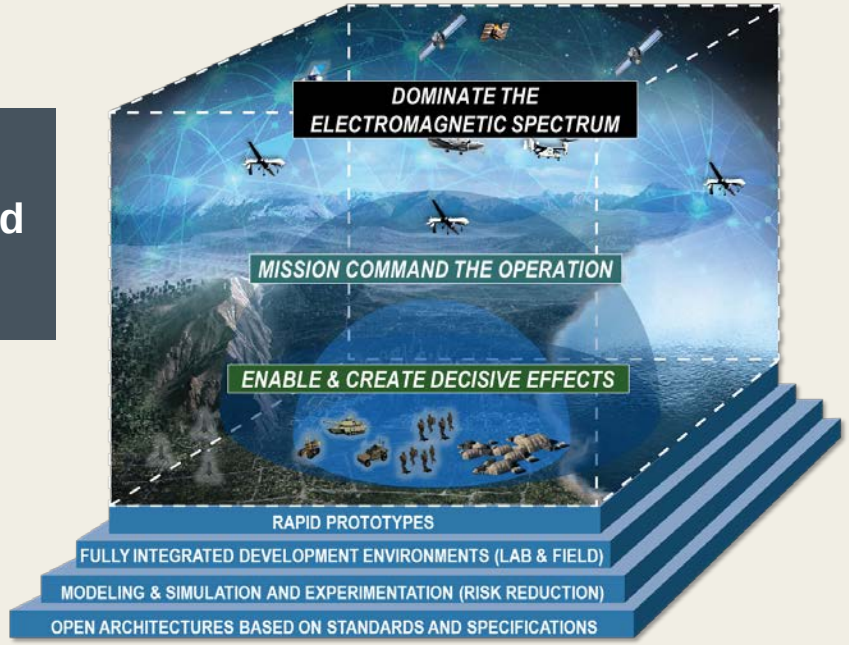
Operational Energy

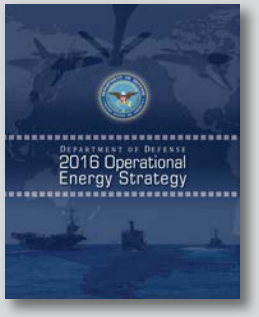
Operational Energy

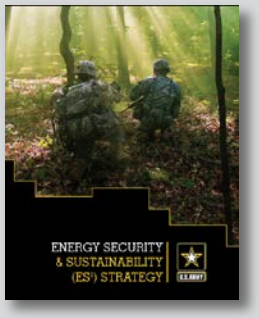
- Discuss Operational Energy strategy and long term goals
- Provide information on Operational Energy priorities and planned projects
- Provide challenges for technical engagement and partnership opportunities

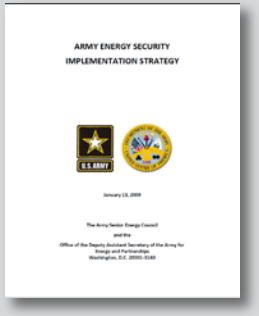
Supports all CERDEC Thrusts as cross cutting and enabling technology



Operational Energy Strategic Guidance and Goals







Strategic Guidance

- Increase Future Warfighter Capability
- Identify and Reduce Risks
- Enhance Mission Effectiveness
- Inform Decisions – Leverage Army Culture
- Optimize Use – Increase Efficiencies
- Assure Access – Provide Reliable Availability
- Build Resiliency – Advanced Capabilities
- Drive Innovations – Encourage New Concepts

Operational Energy Goals

- Reduce Energy Consumption
- Increase Energy Efficiency across Platforms and Facilities
- Increase Use of Renewable/Alternative Energy
- Assure Access to Sufficient Energy Supplies
- Reduce Adverse Impacts on the Environment

Technology Focus Areas

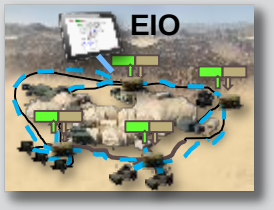
Power Sources
Batteries Capacitors

Power Generation
Fuel to Electricity Conversion

Renewables

Energy Harvesting

Power Distribution
Wireless Power



Power Management & Control

Soldier & Small Unit (up to 2kW)

Portable Power Generation

Conformal Wearable Battery

Wireless Power

Kinetic Energy Harvesting

Intelligent Tactical Micro-Grids (up to 360kW)

Tactical Loads

On Board Vehicle Power

Tactical Generators

Power Distribution and Communications

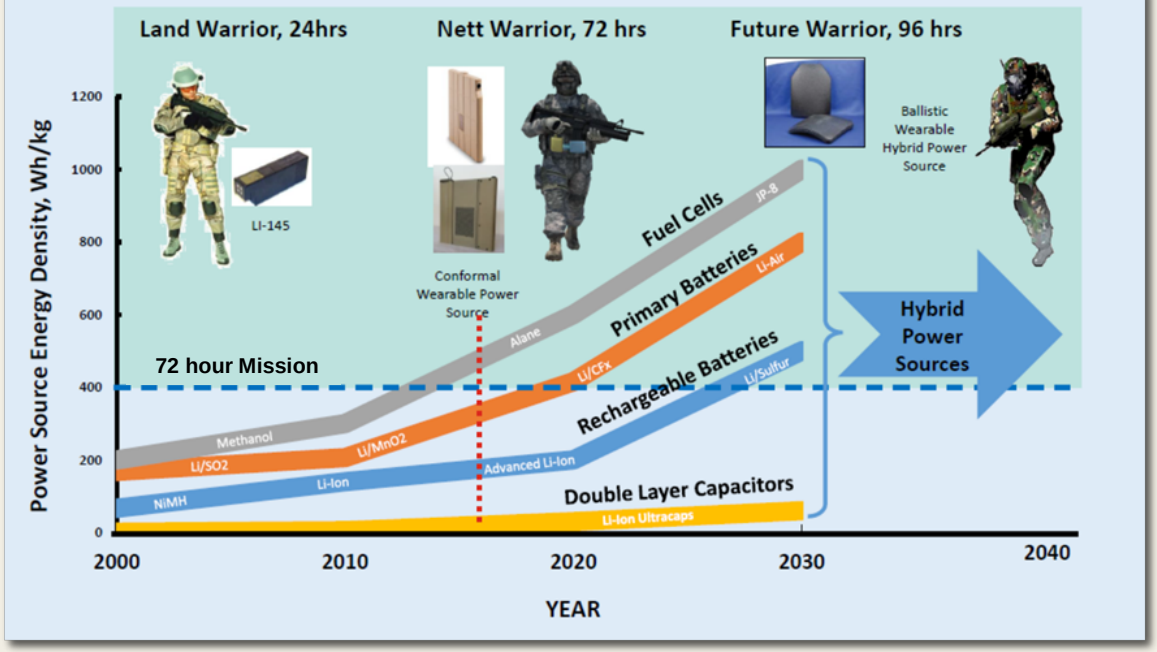
Renewables

Energy Storage

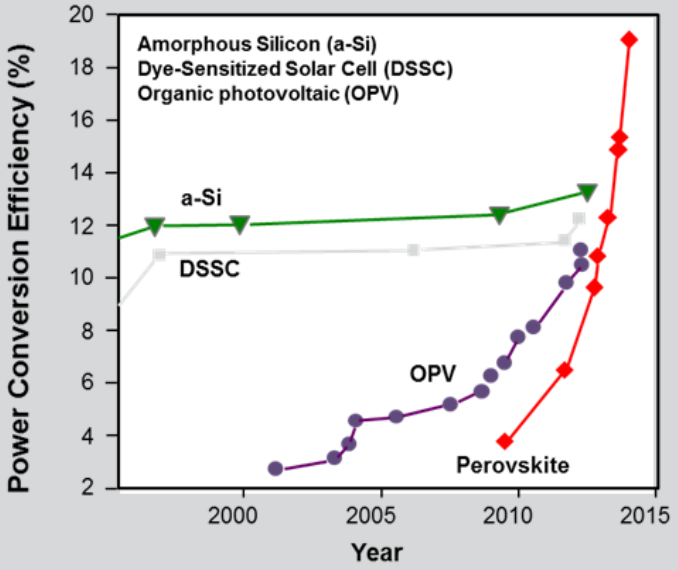
Energy Informed Operations Application

Operational Energy Trends

Soldier Power Trends



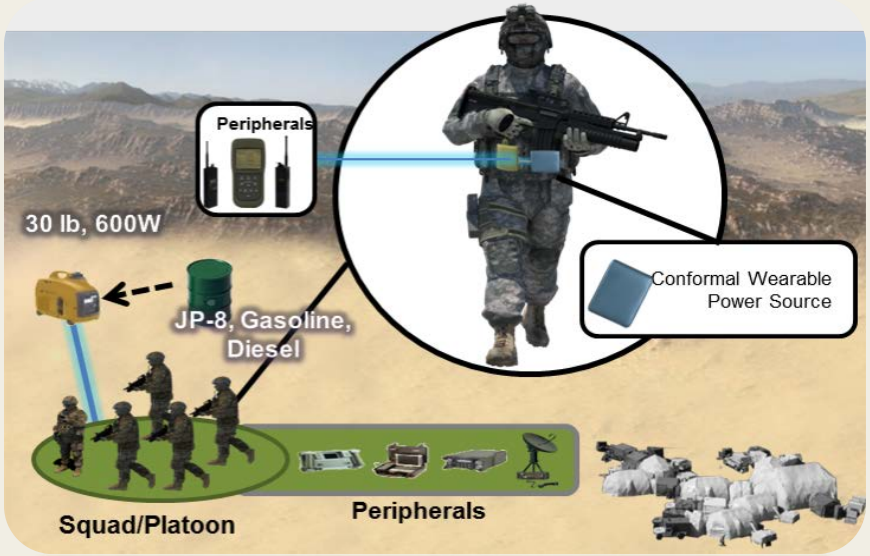
Renewable Energy Trends



Operational Energy Requirements

	High Level Required Capability	Capability Gaps	Specific Need	S&T Efforts
NEAR TERM (18-22)	Lighten the Soldier load	Maneuver Center of Excellence (MCOE) Small Unit Power CDD	Platoon - Provide sufficient power to recharge and power all Platoon equipment and fulfill residual power gaps at the Squad and Soldier level. Squad - Provide sources of power in austere environments where no power source exists. Soldier - Provide supplemental power to the conformal battery thus extending time between battery exchanges. Soldiers will require the ability to seamlessly interface their systems with a variety of energy sources and have the ability to monitor individual and SUP systems and energy status.	Advanced Integrated Soldier Power (AISP) Self-Sustaining Soldier Power
	Use power and energy resources efficiently	Army P&E Strategy WP – Grand Challenges 1, 2, and 3 Army Warfighting Challenge 16 CASCOM Technology and Capability Objectives for Force 2025 and Beyond	Significantly reduce requirements to transport fuel in an expeditionary environment. Maintain freedom of movement Provide intelligent power management and distribution	Ad hoc, In-Situ Power Management Wireless Power
	Understand the impact of energy on mission	Operational Energy ICD CASCOM Technology and Capability Objectives for Force 2025 and Beyond	Provide Soldiers and leaders a means to manage – measure, monitor and control energy status, usage and system performance; prioritize and redistribute resources. Integrate ability to generate, collect, control and analyze energy demand and consumption with Mission Command.	Expeditionary Mission Command – Energy Informed Operations

Advanced Integrated Soldier Power (AISP)



Purpose:

Advanced electrochemical materials and energy harvesting component level research and development that provides more efficient Soldier and small unit power and energy technologies with enhanced safety features and the ability to be integrated into existing products.

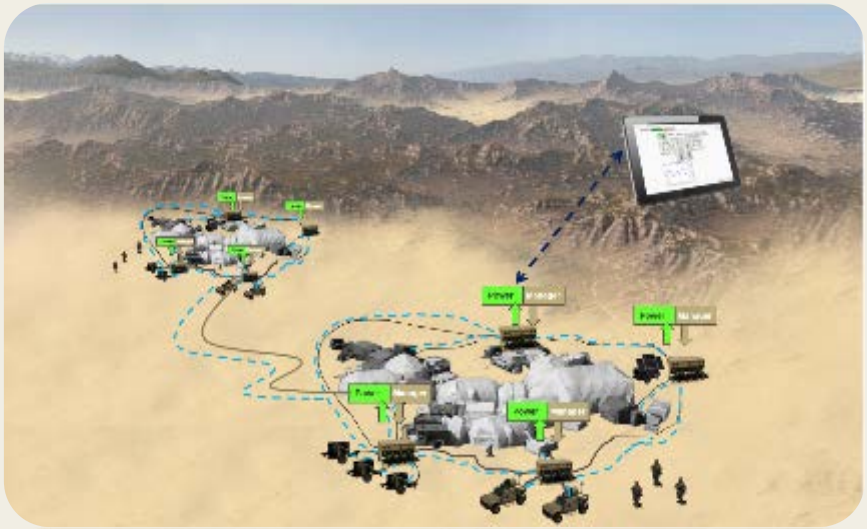
Products:

- Energy Harvesting Devices for Soldier Power Generation to include investigation of component level improvements for kinetic devices
- Advanced electrochemical/electrostatic materials for safe conformal wearable power sources to include both primary and rechargeable battery chemistries and ultra capacitors
- Compact fueled power sources for increased energy on the move to include novel fuel cell and component development and compact portable combustor for electric power

Payoff:

- **Reduce Soldier burden:** Nearly eliminates the large quantities of heavy military batteries further unburdening the Soldier as centralized power sources get smaller and significantly increase in energy
- **Reduce logistical burden:** Self-generation reduces the need for energy sustainment in austere locations
- **Increased mission duration:** Improved power densities and power generation while on the move enable extended operations beyond 72 hours

Expeditionary Mission Command Energy Informed Operations (EIO)



Purpose:

Develop advanced power network control standards, and applications to enable high penetration of renewable technologies, ad-hoc arrangements and minimize wasted power in modular, scalable grids for self-sustaining Soldiers and base camps.

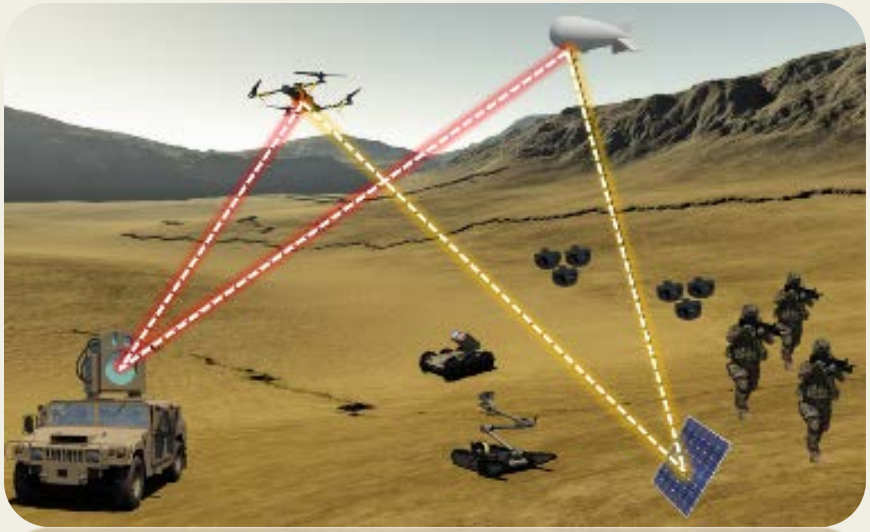
Products:

- Control Standards for Distributed Power Systems
  - Distributed Resource Control Standards
  - Secure Wireless Communications
- Energy Predictive Applications for Power Management
  - Prognostics and Diagnostics of Intelligent Power Systems
  - Predictive Applications for integration and optimization of highly renewable and unstable grids

Payoff:

- Reduced dependency on resupply and reduced cost and logistics burden of fuel and battery resupply
- Ability to tailor power system based on operational environment and mission conditions
- More flexible and sustainable energy network to support extended missions with minimized logistics footprint

Wireless Power Transfer



Purpose:

- To beam power to stand-off devices over large distances
- To enable contactless battery charging in vehicle and TOC

Products:

- Magnetic and electric resonant power: short range C4ISR devices, 5-100 watt transfer capability.
- Laser beaming: up to several miles, 300-1000 watt transfer capability.
- Microwave beaming: up to a mile, 200-1000 watt transfer capability.

Payoff:

- Power supply to stand-off sensors for SA and force protection
- Personnel-safe delivery of power to hostile environments
  over large distances.
- Extended UAV surveillance >= improved force protection
  and battle-space visualization.
- Delivery of electric power to remote and hostile locations

Opportunity to evaluate the Readiness of Capabilities in an Integrated Environment beyond the Traditional Lab Setting

Army Expeditionary Warrior Experiment (AEWE)
Maneuver Center of Excellence (MCOE), Fort Benning, GA

Maneuvers Fires Integration Exercise (MFIX)
Maneuvers Fires Battle Lab, Fort Benning, GA

CERDEC Ground Activity
Joint Base Mcguire-Dix-Lakehurst, NJ

Base Camp Integration Lab (BCIL)
PM Force Sustainment Systems (PM FSS),
Fort Devens, MA

Contingency Basing Integration Technology Evaluation Center (CBITEC)
Maneuver Support Center of Excellence (MSCOE),
Fort Leonard Wood, MO

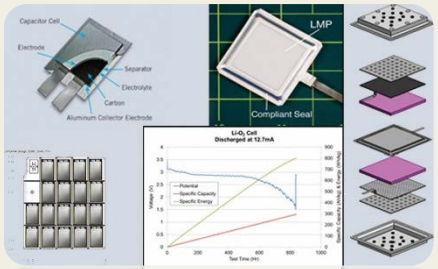
Network Integration Event (NIE) and Army Warfighting Assessments (AWA)
Brigade Modernization Command, Fort Bliss, TX







Summary of Challenges

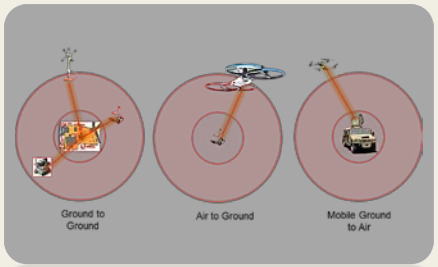


Electrochemical Materials

- Primary Batteries: >600 Wh/kg
- Rechargeable Batteries: >300 Wh/kg
- Supercapacitors: 60 Wh/kg and 10kW/kg

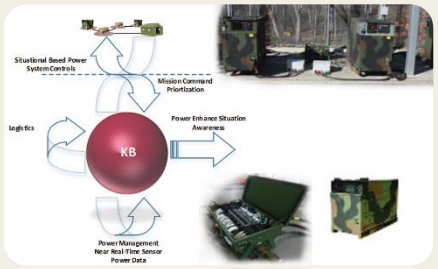
Energy Harvesting

- Kinetic Energy
  - Capturing Low Frequency Motion
  - Capturing Instantaneous Strike Energy
  - >2.5 W/kg, continuous DC
  - Goal: 10W with 1kg
- Solar
  - Goal: > 25% Efficient PV



Wireless Power

- Receiving Diode
- Safety
- SWAP
- Goals:
  - >100W
  - >500m



Micro-Grids

- Tactical Grid-Tied Inverter w/ Anti-Islanding Controls
- Grid Stability and Controls
- Generator Tuning
- Secure Wireless Communications
- Grid Prognostics and Diagnostics
- Load Sharing Methodology