"Army Power & Energy:
Enhancing Mission Effectiveness,
While Preserving Future Choices"

11 October 2011

1000 – 1200, AUSA, Room 152A/B

Army Power & Energy ILW Panel

"Army Power & Energy:
Enhancing Mission Effectiveness, While Preserving Future Choices"
11 October 2011, 1000-1200, Room 152A/B

Distinguished Panel Members include:

Ms. Katherine Hammack
Assistant Secretary of the Army for Installations, Energy & Environment

MG Al Aycock
Director of Operations, Assistant Chief of Staff for Installation Management

MG Dana J. H. Pittard
Commanding General, Fort Bliss, Texas

MG Raymond V. Mason
Assistant Deputy Chief of Staff, G-4

MG Nikolas "Nick" G. Justice
Commanding General, US Army Research , Development & Engineering Command

Dr. Grace M. Bochenek
Director, US Army TARDEC

Closing Comments by:

Mr. Richard Kidd
Deputy Assistant Secretary of the Army for Energy & Sustainability &
Senior Energy Executive, OASA (IE&E)

Army Power and Energy

Basing

- Installation
- Contingency

Soldier

Vehicles

- Tactical
- Non Tactical
  - Air
  - Land

OPERATIONAL ENERGY

NET ZERO STRATEGY

"Grand Challenges"

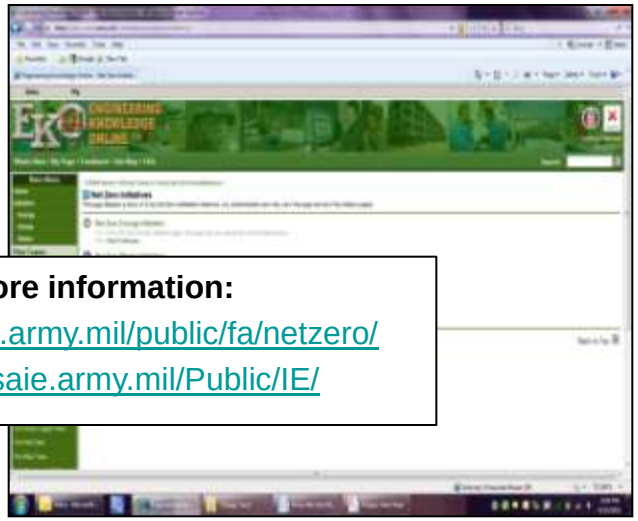
- Give soldiers and leaders capability to manage energy status, resources, performance
- Significantly reduce energy footprint
- Provide flexibility and resiliency by developing alternatives and adaptable capabilities

Power and Energy Strategy White Paper, Army Capabilities Integration Center/Research, Development and Engineering Command /Deputy Chief of Staff, G-4, US Army, 1 April 2010

Basing – Net Zero Installations

Energy	Water	Waste
Fort Bliss, TX		
Fort Carson, CO		
Fort Detrick, MD	Aberdeen PG, MD	Fort Detrick, MD
Fort Hunter Liggett, CA	Camp Rilea, OR	Fort Hood, TX
Kwajalein Atoll, RMI	Fort Buchanan, PR	Fort Hunter Liggett, CA
Parks Reserve Forces TA, CA	Fort Riley, KS	Fort Polk, LA
Sierra AD, CA	JB Lewis-McChord, WA	JB Lewis-McChord, WA
West Point, NY	Tobyhanna AD, PA	USAG Grafenwoehr
Oregon ARNG (statewide)		

- **A Net Zero ENERGY Installation** produces as much energy on site as it uses, over the course of a year
- **A Net Zero WATER Installation** limits the consumption of freshwater resources & returns water back to the same watershed so not to deplete the groundwater & surface water resources of that region in quantity or quality
- **A Net Zero WASTE Installation** reduces, reuses, & recovers waste streams, converting them to resource values with zero solid waste to landfill
- **A Net ZERO INSTALLATION** applies an integrated approach to management of energy, water, & waste to capture & commercialize the resource value and/or enhance the ecological productivity of land, water, & air

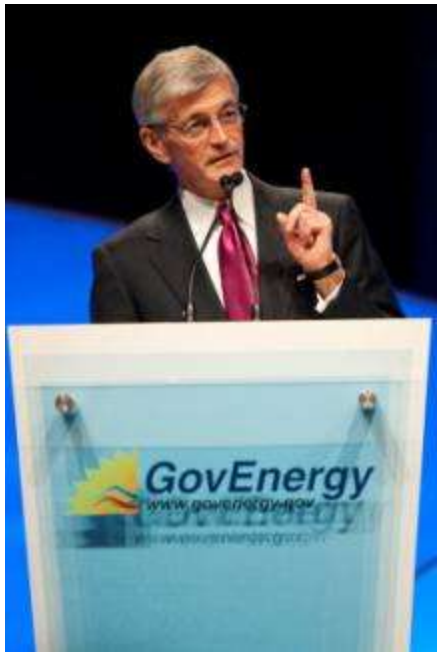


For more information:

https://eko.usace.army.mil/public/fa/netzero/

http://www.asaie.army.mil/Public/IE/

Energy Initiatives Task Force



EITF announced by SecArmy on 10 August 2011, opened 15 September.

EITF is a one stop shop for collaboration with the private sector to invest in cost-effective large-scale renewable energy projects on Army Installations.

Goals:

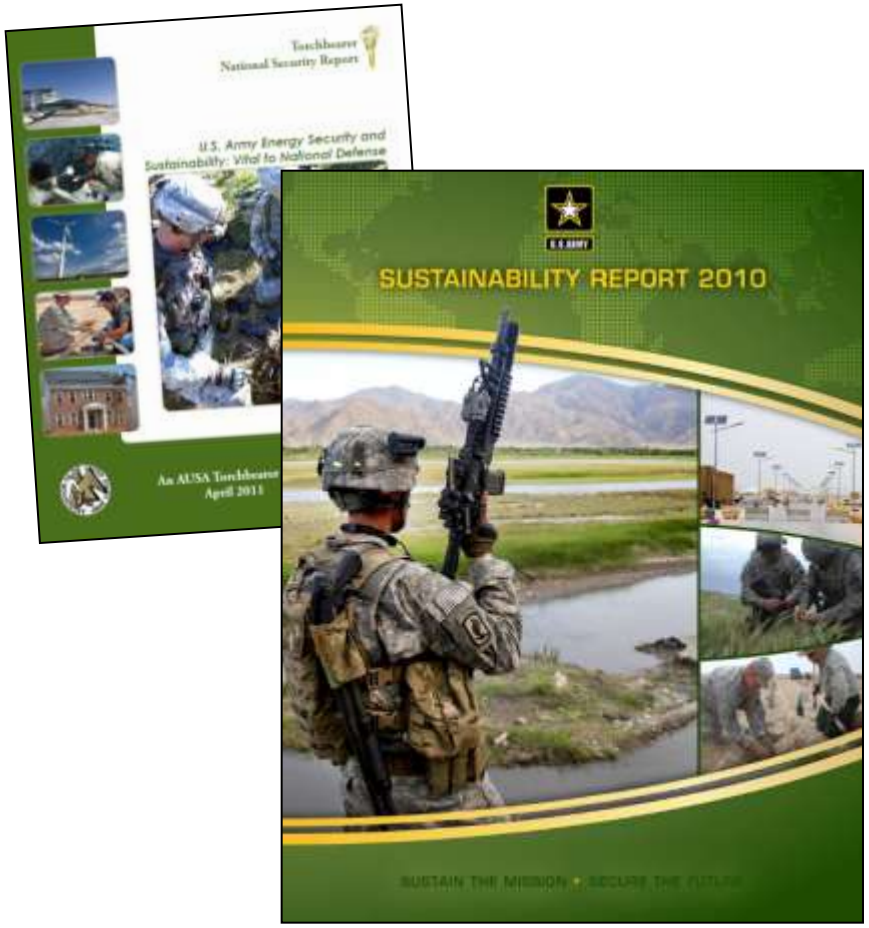
- Increase Army's Energy Security.
- Meet Goal of 25% RE by 2025 with additional **2.1 million MWh annually**.
- Attract an estimated **$7.1 Billion** in private investment over next 10 years.

We've got the LAND and the DEMAND!!

Operational Energy Focus

- Reduces reliance on vulnerable Resupply Operations -- enables greater operational freedom of action
- Reduce Soldier's load
- Supports theater requirements
- Conserves Resources

Army Sustainability Report



- Third public sustainability report
- Aligns with the *Army Sustainability Campaign Plan* & reports 2009 progress in:
  - Land-use planning
  - Community partnerships
  - Pollution prevention
  - Green buildings
- Will facilitate future public reporting of Army progress against the EO 13514 & DoD sustainability goals for FY10 & beyond

Report available on Oct 11, 2011 at: http://www.aepi.army.mil/

Army Installation Energy Initiatives

MG Al Aycock
Director of Operations
Assistant Chief of Staff for Installation Management

Ends, Ways and Means

Constant
- Ends: Provide Army Energy Security; Reduce Energy & Water Consumption; Expand Use of Renewable Energy Sources

Must Change
- Ways: Installation Management Campaign Plan LOE#6; Energy Initiatives Task Force; Energy Efficient Facilities; Net Zero Energy, Waste, and Water Strategy; Exercise All Contracting Authorities; Leverage Third Party Financing; Culture Change

Decreasing
- Means: Army Budget

Army Programs for Success

Utilities Services

- $1.3 Billion Program in FY 10 – Doubled since FY06 ($668 M)
- Consumption up in FY09 & 10
- Improving efficiency – But still lots of room for improvement
- Largest Utilities Privatization Program in DOD – evaluated 304 of 355 utility systems, privatized 147 systems

Alternative Financing

- 126 renewable projects produce 195,000 MWH annually (2% of goal)
- Need additional 2,240,000 MWH annually for goal of 25% renewable
- Energy Initiatives Task Force to attract 3rd party investment and facilitate new projects; Goal = $ 7 Billion investment
- ESPC/UESC have over $1.4 B in private sector investment in efficiency projects

Appropriated Funds

- O&M program – Over $200 M in energy efficiency projects funded in FY11. Targeting future Modernization Funding for energy across all components
- Energy Conservation Investment Program (ECIP) ~ $50M per year providing small renewables and energy efficiency projects
- MILCON – applying most stringent standard in DOD – ASHRAE 189.1 standards full compliance in FY13 program

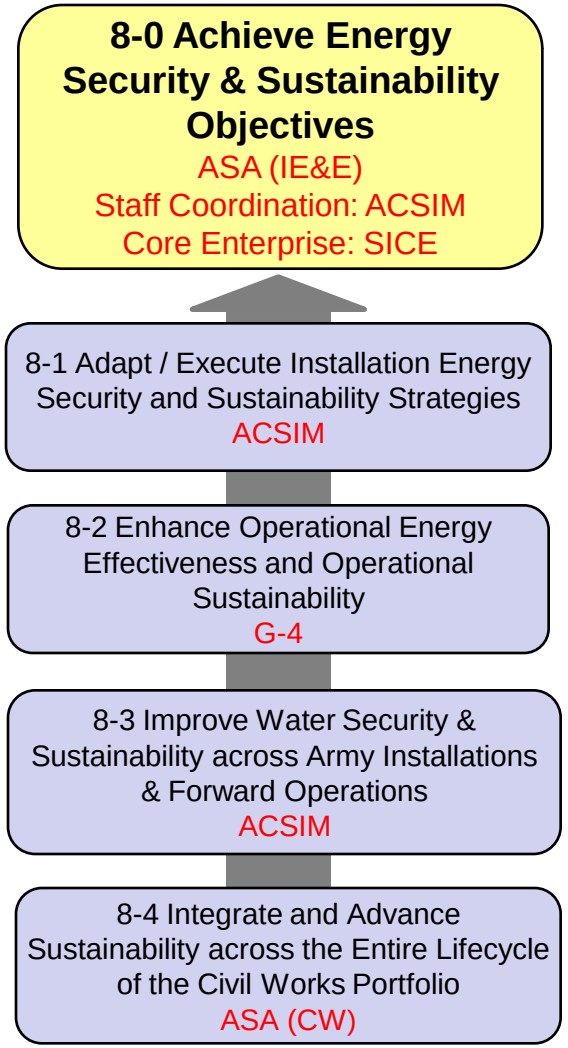
Non-Tactical Vehicles (NTV)

- 3rd Largest Hybrid fleet in Federal Government
- Acquiring 109 Electric Vehicles in next 6 months – Electrify fleet
- 75% of NTV fleet light duty vehicles are currently alternative fuel vehicles.
- Army uses more E-85 fuel than any other Federal Agency

ILW Power & Energy Panel

- Senior Energy & Sustainability Council (SESC) task completed
  - Identified 30 strategic energy and sustainability metrics for Army Campaign Plan (ACP) 2011
- On 15 July 2011, SECARMY directed creation of an Energy Campaign Plan Objective in ACP 2012
- The energy and sustainability strategic metrics will inform the ACP 2012

Draft ACP 2012 Strategy Map (16 Aug 11)



Installation Energy Program Way Ahead

- **Manage People/Change Army culture to incorporate energy security**
  - Make energy consideration in all work, training, life activities – develop Net Zero lifestyle
  - Give soldiers and leaders capability to manage energy status, resources, performance.

- **Improve Energy Efficiency**
  - Implement policies / Drive action to significantly reduce energy footprint.
  - Execute MILCON to meet ASHRAE 189.1 standards for energy efficiency
  - Leverage public private authorities to accelerate efficiency projects by ESPC and UESC

- **Expand Alternative/Renewable Energy**
  - Attract private investment to develop large scale renewable energy projects
  - Installations must work with the ASA (IE&E) Energy Initiatives Task Force to identify, prioritize, develop, implement large-scale renewable and alternative energy projects

- **Incorporate Science and Technology**
  - Leverage modern technology to replace old generation systems and practices

AUSA – Basing Power

Major General Dana J. H. Pittard
Commanding General First Armored Division
Fort Bliss, Texas

What is the Goal and Where Have We Been?

- 33,000+ Soldiers
- 1.1 Million Acres
  Projected
- 500 GW-hours/yr
- 70-90MW Peak

Net Zero Energy

- Solar Thermal
- Solar PV
- UMCS
- Equipment/Motor Efficiency

ESPC

ESTCP

- Intelligent MicroGrid Clusters
- Daylight Redirecting Films
- High Gain Solar Technology

- Hybrid Cooling
- Building Envelops
- Lighting Efficiency
- Solar PV

ARRA

ECIP

- Solar Day-Lighting
- Lighting Efficiency
- Tent Spray-On Insulation

Results

ANNUAL REDUCTION OF GREEN HOUSE GASSES

- Affects CO2, NOx and pollutants such as SO2
- 7.5% reduction of Fort Bliss CO2 emissions

SMALL SCALE RENEWABLES

- SOLAR PV
- 34 BUILDINGS
- 1.1 MW Distributed

TOTALS

- EFFECTED SQUARE FOOTAGE 17.8M
- ANNUAL COST SAVINGS $2,771,320.00

Where Are We Going?
Large Scale Renewable Energy

Near-Term Push to Burn Path to Success

- **Multiple 5 to 20+MW Solar Photovoltaic Plants**
- **13.2MW Rooftop Solar Photovoltaic Distributed Generation**
- **Evaluation of innovative Unsolicited Proposals (90MW Wind)**
- **ESPC to start Solar Photovoltaic Plant and MicroGrid at Training Ranges with >1.1MW PV**
- **90MW Waste-To-Energy and Concentrated Solar Thermal Plant**

ASA, Garrison, & Integration Contractor Planning and Execution

Renewable Energy Planning & Integration

- **IMCOM Lines of Effort**
- **"Bridge" Renewable Energy Integrator**
- **Long Term Integrator ESPC Contract**
- **Energy Initiatives Task Force (ASA IE&E)**

20+MW Solar PV RFP's by 1Q12

Challenges and Approach

- Utility/State Regulatory Environment
- Cost of Renewable Energy
- Approval Process Hurdles

Teaming at All Levels of the Army

- Find Successful Legal and Contracting Path Forward
- Army Definition and Approval of the True Cost of Net Zero & Renewable Energy for the Army
- Consolidated Process for Project Approval to Meet Mission Goal Timelines

Fort Bliss will strive to push / pull the implementation of renewable energy to become the premier Net Zero Installation for the Army







Power and Energy:
Enhancing Mission Effectiveness while Preserving Future Choices

11 October 2011

★ ★ ★

MG Raymond Mason
Office of the Deputy Chief of Staff, G-4
Headquarters, Department of the Army

AMERICA'S ARMY: THE STRENGTH OF THE NATION

Agenda

- Operational Energy Overview
- Strategy and Plans
- Current Operational Energy Actions
- Emerging Operational Energy Initiatives
- Innovation

What is it?:

The energy and associated systems, information and processes required to train, move, and sustain forces and systems for military operations.

Operational Energy Initial Capabilities Document (ICD), draft version 1.4, 29 July 2011

Operational Energy Overview (BLUF)

Why we need it…

1. **Strategic:**
   - "Energy state relationships intersect geopolitical concerns as state-run companies control an increasing share of the world's hydrocarbon resources…" (NMS 2011)
2. **Operational:**
   - 70-80% of convoys deliver fuel and water in a typical theater
   - Fully burdened cost of fuel (FBCF) as high as $50 /gal in Afghanistan
3. **Tactical:**
   - 18% of US casualties in OIF and OEF are related to ground resupply
     - 3,000+ casualties in resupply missions in OEF/OND
     - 1,100 attacks on U.S. Ground Convoys in OEF

1 Casualty/ 46 Convoys in OEF

What we're doing…

And More!!!

1. **Strategic Partnerships:**
   - OSD
   - Joint Partners
   - ASA(IEE)
   - ASA (ALT)
   - AMC
   - TRADOC/CASCOM
   - ARSTAF
   - Industry/Academia
2. **Army Campaign Plan:**
   - Campaign Obj 2.0… (2.8) Institutionalize Contingency Basing
   - Campaign Obj 8.0… (8.2) Enhance Operational Energy Effectiveness & Operational Sustainability
3. **Institutionalize Successes:**
   - FBCF tool available DOD-wide
   - Creating efficient base camp ***design standards*** to integrate into acquisition and contracting requirements
4. **POM/Budget:**
   - Build Operational Energy into Standard Army Requirements and Funding Processes

Strategy and Plans

Key Strategic Documents

29 Jul 11

Operational Energy - Initial Capabilities Document (ICD)

Army Energy Security Implementation Strategy (AESIS)

13 Jan 09

CENTCOM Operational Energy Documents

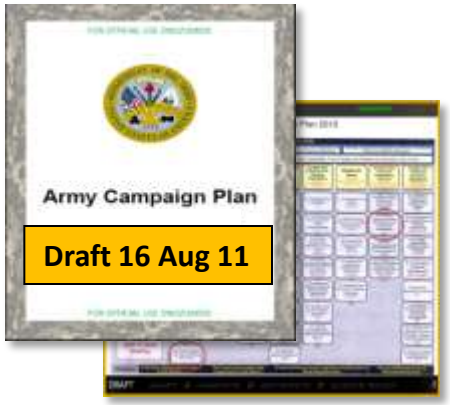
Tactical Fuel and Energy Implementation Plan

24 Sep 10

Army Power and Energy White Paper

1 Apr 10

Army Campaign Plan



Draft 16 Aug 11

Campaign Objective 2.0

Provide Facilities, Programs & Services to Support the Army and Army Families

2-8 Institutionalize Contingency Basing

Campaign Objective 8.0

Improve Energy Security and Sustainability

Major Objective 8-2 Enhance Operational Energy Effectiveness & Operational Sustainability

Operational Energy & Contingency Basing Campaign Plans

Operational Energy Campaign Plan

TBP Dec 11

Contingency Basing Campaign Plan

Draft v0.2, 30 Jul 11

Operational Energy Goals and Outcomes

Performance Goals
- Increase mobility
- Increase mission focus
- Extend endurance
- Increase availability
- Reduce fully-burdened cost
- Enhance stability operations

Operational Outcome
- Lethal
- Agile
- Expeditionary
- Interoperable
- Versatile
- Sustainable

Optimize Logistics Footprint..Mitigate Risks

- **A Few Things We Must Achieve**:
  - Support COCOM Requirements
  - Reduce Soldier's Load
  - Enable greater Operational Freedom of Action
  - Conserve Resources
  - Reduce reliance on Vulnerable Resupply Operations

Grand Challenges:
- Give soldiers and leaders capability to *manage energy* status, resources, performance
- Significantly *reduce* energy *footprint*
- Provide *flexibility* and resiliency by *developing alternatives* and adaptable capabilities

Power and Energy Strategy White Paper, Army Capabilities Integration Center; Research, Development and Engineering Command; Deputy Chief of Staff, G-4, US Army, 1 April 2010

Current Operational Energy Actions (1 of 3)

Tactical Fuels Manager Defense (TFMD):

- ***Automated system to track fuel requirements, inventory, and consumption at the retail level to improve visibility of fuels in theater***, enhance accountability (AMC/Army Petroleum Center)
- Will be used to inform Army Future Requirements
- Potential for inclusion in Network Integration Enterprise (NIE) 13.1

From Manual to Automated Accounting

Tactical Fuels Manager Defense

USACE Mini-Grids for USFOR-A:

- ***22 mini-grids installed*** with central power generation and distribution to replace spot-generation
  - ***Saving 33M gallons of fuel per year (past 2 yr avg 255M gal of fuel/yr)***

Estimated Savings: 13%

- ***37 task orders in 2011 created 6 new grids*** and extended existing ones to ***save an additional 17M gallons per year.***

Micro-grid Projects

Rucksack Enhanced Portable Power Systems (REPPS):

- ***Lightweight solar-powered kit*** capable of charging batteries or functioning as a continuous power source (RDECOM/CERDEC)
- Sponsored by PM Soldier-Warrior
- ***Included in NIE 12.2 (Ft. Bliss: MAR 2012)***

Reduced Soldier Load*

Rucksack Enhanced Portable Power Systems

Current Operational Energy Actions (2 of 3)

Force Provider (FP) Energy Efficiency Upgrades:

- Deployed Shower Water Reuse Systems to Afghanistan in FY11
- *Allows for reuse of 75% of the shower waste water*
  - *Processes 12,000 gal shower waste water per day*
  - *62 fielded to OEF*
- Established Base Camp Systems Integration Laboratory (SIL) at Fort Devens, MA to improve energy efficiency & reduce environmental risks (24 Jun 11)
- *Developing shades and insulated tent liners for 600-Soldier Force Provider modules (20 sets)…Goal is 50% reduction in fuel consumption*
- Evaluating micro-grid systems integrated with the standard 60 kW Tactical Quiet Generators (TQG)

Saves 9,000 gallons/day

Shower Water Reuse System

Microgrid and 60 kW TQGs

R-26 (Shelter) Vs. R-2 (tent)

Rigid Wall Shelters / Re-locatable Buildings:

- *Evaluating energy-efficient rigid wall shelters and re-locatable buildings*
- Results of evaluation will be incorporated into Performance Specification to be used for future procurement actions

Energy Efficient Shelters

59% Less Energy than Standard Tents

Current Operational Energy Actions (3 of 3)

Advanced Medium-sized Mobile Power Sources (AMMPS):

- Lighter, more fuel efficient, next generation generators
  - ***Replaces current Tactical Quiet Generators*** (PM MEP)
- On track to replace TQGs in USFOR-A ***starting in Jan 2012***
- ***Range in size from 5 kW to 60 kW***

Advanced Medium-sized Mobile Power Sources (AMMPS)

Uses an avg. of 20% less fuel than current sets fielded

Logistics Civil Augmentation Program (LOGCAP):

- LOGCAP IV umbrella ***contract requires consideration of energy efficient solutions***
- ***Directs contractors to identify Energy Savings Initiatives*** (ESIs) in current operations (47 submitted and 24 completed)
- Streamlined ESI review and approval process
- Incorporating Process/Practice Improvements in CENTCOM
- ***Execution plan finalized Sep 2011*** (G-4/AMC/USFOR-A)

18 ESIs Completed = 152 Trucks (5K) off the road

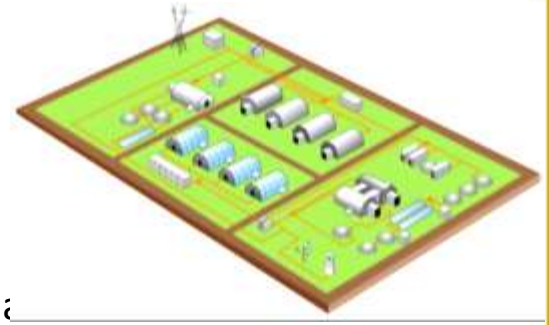
Emerging Operational Energy Initiatives

Operational Energy Campaign Plan

- Builds foundation for an ***integrated, synchronized plan of action***
- Composed of campaign tasks and integrating activities that ***will enhance operational energy effectiveness and operational sustainability***
- ***Links operational energy strategic goals and objectives, Army Campaign Plan tasks, OE Initial Capabilities Document*** and other guidance to actionable tasks
- Informs key Army processes (i.e., Army Program Objective Memorandum, Capabilities Needs Analysis, and the Army Experimentation)

Smart and Green Energy (SAGE)

- Create a resource-efficient ***base camp design to reduce fuel demand by 30-60%***
- Proof-of-concept that ***utilizes smart grid power management, energy storage, energy efficient shelters and renewable energy***
- Partnering with PM FSS to initiate proof-of concept assessment (Systems Integration Laboratory (SIL) at Ft Devens, 1Q FY12)



Smart and Green Energy

Brigade Modernization Command (BMC)

- Developing a ***way ahead for Energy and Contingency Basing*** operationa
  testing during Network Integration Evaluation (NIE) 12.2

UNCLASSIFIED

INNOVATION REDUCING THE ENERGY FOOTPRINT

LOGISTICS INNOVATION AGENCY | U.S. ARMY G-4

LIGHTEN THE SOLDIER'S LOAD

POWER SOURCES
- Light weight
- Man-portable
- Energy dense
- Most austere operations

REDUCING DEMAND FOR ENERGY AND WATER

SYSTEM APPROACH
- Developing and deploying renewable technologies for the Soldier, platform, base camp and logistics performance

ENHANCING ENERGY SECURITY AT CONTINGENCY BASE CAMPS

ACTIVE IMPROVEMENTS
- Reducing energy consumption
- Increasing energy efficiency
- Employ energy-efficient shelters, micro-grids, renewable power and reusable water systems

LOGISTICS INNOVATION AGENCY | U.S. ARMY G-4

OFFERING ALTERNATIVE ENERGY SOLUTIONS
MINIMIZING EXPOSURE TO RISK

" Joint Forces must become more expeditionary in nature and will require a smaller logistical footprint in part by reducing large fuel and energy demands"

2011 National Military Strategy 8 Feb 2011

US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

Advancements in Soldier Power

Presentation to the AUSA ILW Panel on "Army Power and Energy Challenges"

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

MG Nickolas G. Justice
Commanding General, RDECOM

11 October 2011

Army Focus

Empower, Unburden and Protect the Soldier to:

SHOOT

MOVE

COMMUNICATE

Energy is a key enabler to maintain the Army's Decisive Edge

Power & Energy Roadmaps

CAPABILITY — **CURRENT** — **DESIRED**

Soldier Power

Army's Standard Family of Batteries

- Conformal Battery & Armor
- Rapid Battery Recharging
- Fuel Cells
- Lower Size & Weight

Vehicle Power

High-Amp Alternators

Power Converters / Inverters

- Fuel Efficient Engines
- Improved Power Generation & Conversion
- Improved Power Control & Distribution
- Cooling & Thermal

Basing Power

Squad-level Battery Recharging

Power Generation

- Lighten the Load
- Reduce Logistics Burden
- Energy Self-Sustainment

Power & Energy Roadmaps

CAPABILITY | CURRENT | DESIRED

Intelligent Power

1MW Microgrid

Energy Networking (Microgrids) Small & Large Scale

Intelligent Power Management & Architecture

Demand Side Management

Green Energy

Air & Wind

Renewable Energy

Waste-to-Energy

Net Zero Power

Non-Traditional Energy Solutions

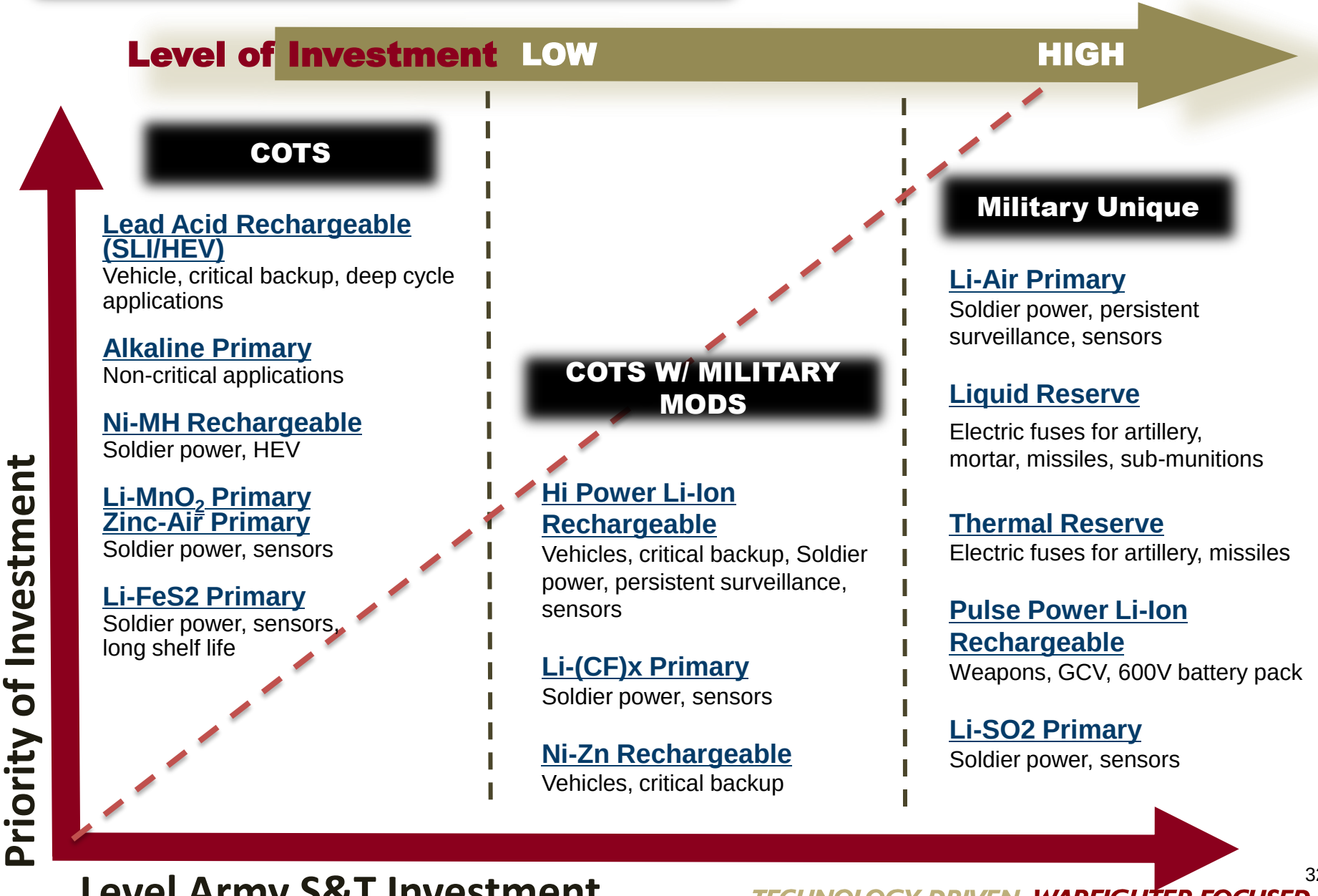
Piezoelectric Harvesting

Solar/PV Fabrics

Bio Mechanical Energy harvesting

Conductive textiles

The Army Battery Story



Army Good News Stories (Past 12-24 Months)

Soldier Power

Conformal Soldier Battery

Novel Zinc-Air Batteries
Light weight Extended Range

Soldier Power Manager

"Half-Sized" BA-5590
Primary Battery

Basing Power

Rucksack Enhanced Portable Power System (REPPS)

Honda 1kW generator **modified** to run **on JP-8**

Methanol Fuel Cell Generator

Green Energy

Zero Base Regenerator
Solar power and water purification

3 kW TQG w/ Solar-stik Hybrid
Integrates small-scale solar & wind with batteries & Tactical Quiet Generator (TQG)

PEAK, Pre-positioned Expeditionary Assistance Kit for solar power and water purification

Power and Energy S&T in Soldiers hands today

Promising S&T Investments

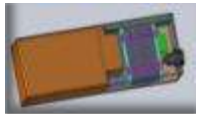
Soldier Power

Conformal Soldier Battery

Wireless Power Transfer

Rapid Charging Technology

Basing Power



Hybrid Fuel Cells

Fuel Cells

Scalable Micro Grids

Waste –To– Energy

Vehicle Power

On-Board Power Generation

High Temperature SiC Modules

Victory Architecture

Army S&T Future Initiatives

- Chemistries to Save Weight
  - High Energy Density Batteries
- Flexible / Scalable Aux Power Units (APUs)
  - Low Temp, Quiet, Low Signature
  - Fuel Cells, Detached Generators
- Smart Microgrids
- Conformal Batteries and Armor
- Energy Smart Usage
  - Net Zero Energy
- Smart Energy Harvesting
  - Photovoltaics, Piezoelectric

Questions?

Army Power and Energy: Enhancing Mission Effectiveness, While Preserving Future Choices Vehicle Perspective

AUSA 2011 Annual Meeting & Exposition

11 October 2011

Dr. Grace M. Bochenek,
Director

U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (TARDEC)

Army Technical Challenge
More Mobile, Fuel Efficient, Safer Vehicles

Power, Energy & Mobility

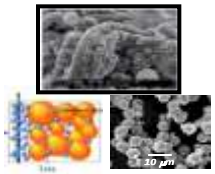
Vehicle Dynamics

Newton-Euler Equations of Motion

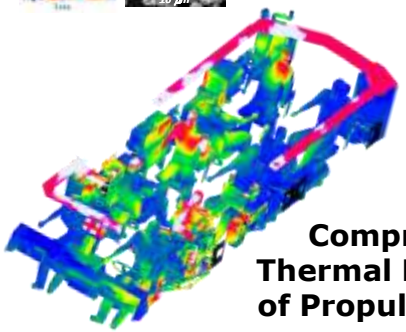
$$\left.\begin{aligned}\mathbf{M}\ddot{\mathbf{q}}+\mathbf{C}_{\mathbf{q}}^{T}\boldsymbol{\lambda}=\mathbf{Q}\\ \mathbf{C}(\mathbf{q},t)=\mathbf{0}\end{aligned}\right\}$$

Solve for vehicle mobility and component loads

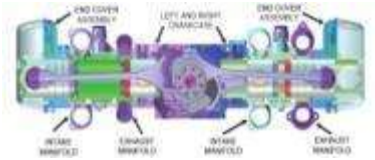
$$\begin{bmatrix}\mathbf{M} & \mathbf{C}_{\mathbf{q}}^{T}\\ \mathbf{C}_{\mathbf{q}} & \mathbf{0}\end{bmatrix}\begin{bmatrix}\ddot{\mathbf{q}}\\ \boldsymbol{\lambda}\end{bmatrix}=\begin{bmatrix}\mathbf{Q}_{e}+\mathbf{Q}_{v}\\ \mathbf{Q}_{d}\end{bmatrix}$$



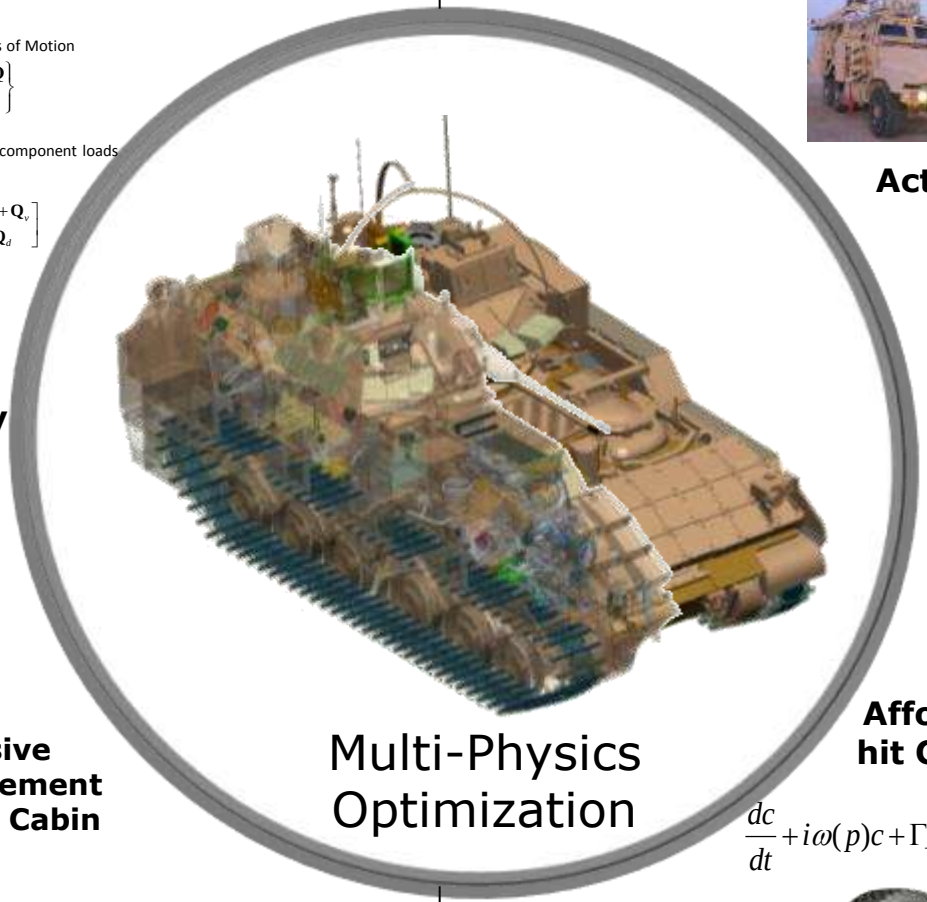
Hi-Energy, Hi-Density Energy Storage



Comprehensive Thermal Management of Propulsion & Cabin



High Power Density, Low Heat Rejection & Fuel Efficient Engines



Multi-Physics Optimization

Soldier & System Survivability

Active Protection Systems

Holistic Occupant Centric Protection

$$\frac{d}{dt}\int_{Vt} f(x,t)dV=\int_{Vc=Vt}\frac{\partial f(x,t)}{\partial t}dV+\int_{Sc=St} f(x,t)\bullet ndS$$

Affordable, Multi-hit Ceramic Armor

$$\frac{dc}{dt}+i\omega(p)c+\Gamma_{+}(p)c-\Gamma_{-}(p)c=f_{\mathrm{n}}(t)$$

Fire and Toxic Fume Resistant Materials

It's About Balancing Technology, Integration, Mission & Threat

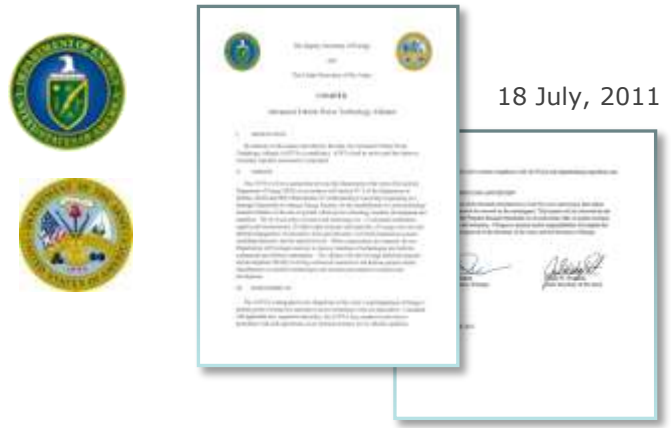
Army/DOE Signs Charter to Achieve Vehicle Energy Efficiency

AVPTA will move us toward reducing our reliance on fossil fuels.

Combines the intellect of the DA and the DOE to accelerate energy-related R&D initiatives.

Advanced Vehicle Power Technology Alliance (AVPTA)

Breaking New Ground



18 July, 2011

- Accelerate technology development & maturation
- Drive innovation
- Increase the value of research investments
- Provide shared capabilities and access to resources
- Partnership with true collaboration to enhance national energy security
- The workshop resulting in:
  - ✓ 37 Coordination opportunities
  - ✓ 21 Opportunities for project integration
  - ✓ 20 Potential joint endeavors

Achieving Common Goals Faster and More Effectively

Advanced Combustion Engines and Transmissions	Lightweight Structures and Materials	Energy Recovery and Thermal Management	Alternative Fuels and Lubricants	Hybrid Power Systems	Analytical Tools
Technical areas for potential joint activity:					
• High density, energy efficient powertrain • Extreme gains in engine efficiency	• Reduce weight to improve performance • Cost reduction for consumer market ❖Lightweight vehicle structure	• Cost Improved efficiency, manage heat generation • Efficiency gains through waste heat recovery ❖Thermoelectrics and Enabling Engine	• Standardization & security • Efficiency gains through advanced oil formulations ❖Test development for fuel bulk modulus	• Efficiency improvements ❖ Computer Aided Engineering for Batteries program (CAEBAT)	• Assessment/ Design Trades

Driving results through collaboration

Advancing Platform Energy Efficiency & System Knowledge

Designed to validate fuel-efficiency innovations, enhance Soldier safety and reduce Army's energy costs.

Visit the FED vehicle at Army Power and Energy Booth. #4224

FUEL EFFICIENT GROUND VEHICLE DEMONSTRATOR

Fuel Efficiency Demonstrator (FED)

OSD Sponsored, Army Implemented

Goals:

- Address energy conservation needs highlighted by the Defense Science Board: Energy Security Task Force
- Improve military vehicle technology to reduce fuel consumption on the battlefield and reduce our dependence on oil
- Achieve 30% increase in fuel efficiency over the M1114

Methodology:

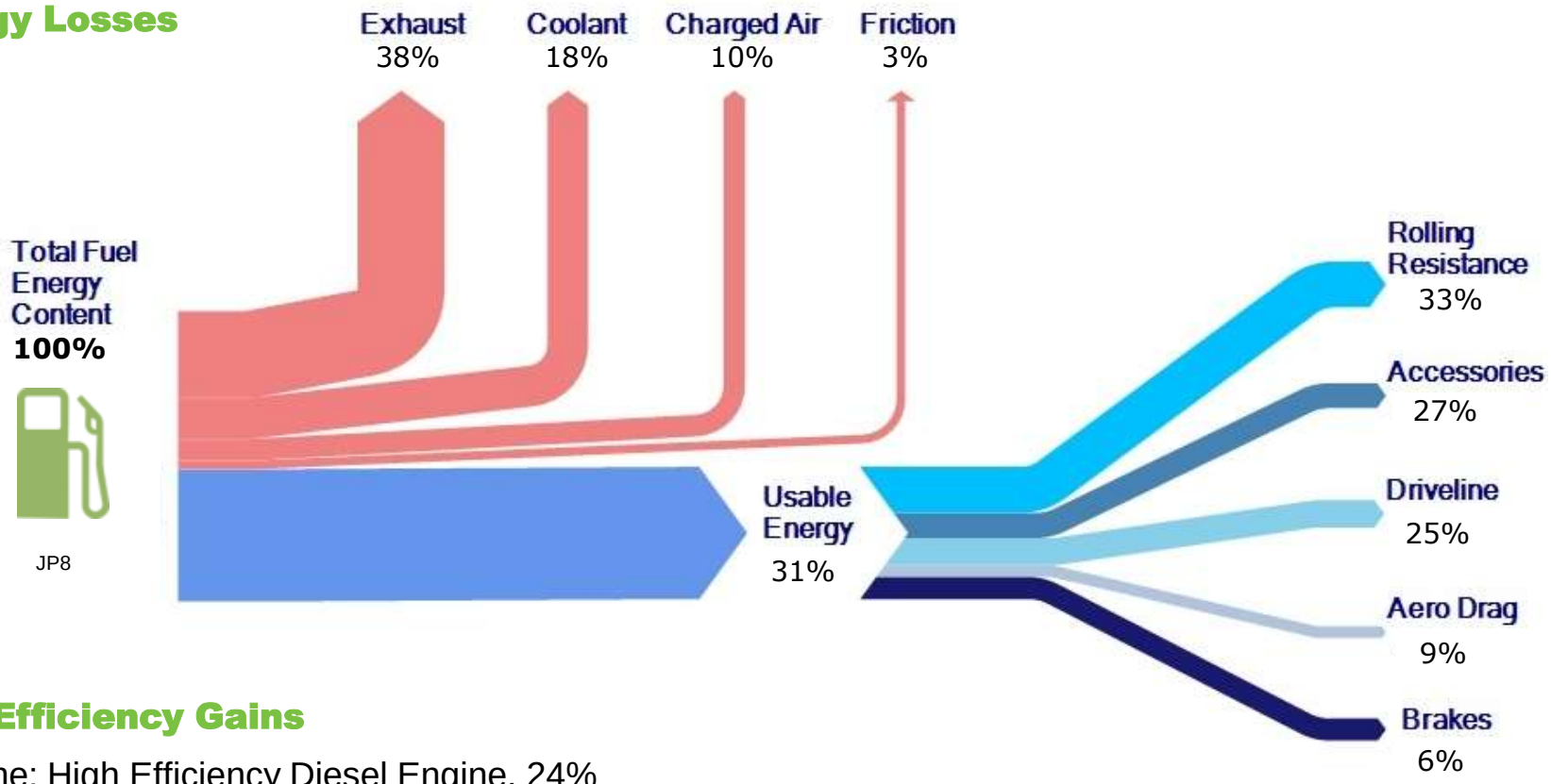
- Non-traditional approach with industry partners resulting in true collaboration and a transparent transfer of the technical data packages (TDP)
- Parallel path approach
  - Embedded Government engineers with contractors (Alpha)
  - "Monster Garage" with subject matter experts (Bravo)

Accomplishments:

- Reached +70% increase in fuel efficiency in Alpha and Bravo – significantly exceeding the original goal
- Efficiency – Fuel economy maximized within the bounds of cost, timing, & threshold requirements
- Optimization –Improve through requirements, specifications, and architecture
- Systems Engineering – Focus on improvement of the whole system, not component optimization

Energy Efficiency Modeling & Simulation

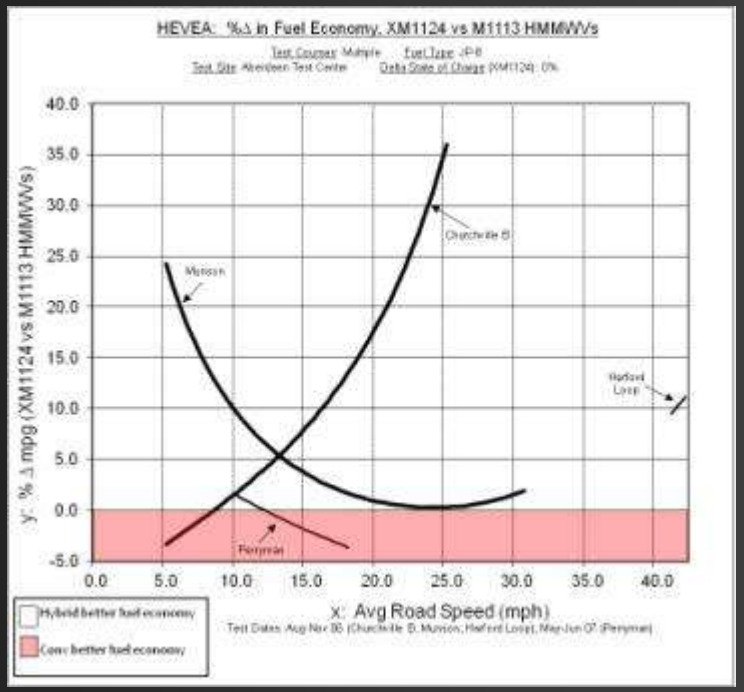
Energy Losses



Fuel Efficiency Gains

- Engine: High Efficiency Diesel Engine, 24%
- Rolling Resistance: Low Rolling Resistance Tires, 8.5%
- Accessories: Integrated Starter Generator, 2.5%
- Driveline: 6 Speed Automatic Transmission , 9%
- Brakes: Lightweight Low Drag Braking System, 1%

Hybrids and Vehicle Electrification



HEVEA – An established method for objective assessment of hybrid electric systems.

Hybrid Electric Vehicle Experimentation and Assessment (HEVEA)

Goals/Accomplishments:

- Developed a standard Test Operations Procedure for testing HEVs (TOP 2-2-603)
- Developed analytical tools for both assessment and evaluation
- Established credible/quantifiable fuel economy & performance data of HEV versus conventional vehicles
- On-going effort to address reliability & cost

Methodology:

- 20 Vehicles (10 Conventional/10 Hybrid; light, medium & heavy; commercial)
- Full Range of courses, environmental conditions
  - APG, YUMA, Cold Regions Test
  - -10° to 100° F
  - Different grades, on & off roads
- Fuel Economy & Performance Tests
- Subsystem Performance Tests (cooling, export power, etc)

Army Efforts…Integral to Installation and Operational Energy Security

Hawaii's Energy from Oil	90%
Hawaii Imports 51 Million Barrels of Oil Annually	$7B
Hawaii's Supply of Oil (at any given time)	14-21 Days

Partnerships

- Hawaii Tri-Service Advanced Vehicle Working Group
- PACOM/NORTHCOM SPIDERS JCTD
- State of Hawaii
- University of Hawaii-HNEI
- Hawaii Tri-Service Military Installations

Army Involvement Achieves Goals

- Supports the increase in renewable energy
- Military as an early adopter
- Develop a competitive & sustaining industry
- **Army Hydrogen based Vehicles & Refueling**
- **Army Aloha Microgrid 1**
  - 250kW AC architecture
- **Army Aloha Microgrid 2**
  - 450kW DC modular architecture

Army – Hybrid Vehicles Contribute to Operation Energy

Hydrogen Vehicles with Internal Combustion Engines(H2ICE)

H2 Station JBPHH

15 H2ICE-vehicles

= Hydrogen
= Electric

U.S. Army Aloha Microgrid 1

25 kW Solar Carport

Grid

4 Plug in, Bi-directional Electric Vehicles, 6kW/each

5 kW Mobile Solar

Two 150 kW Diesel Generators

AC DC

Building Loads

Hydrogen Fuel Cell Vehicles

Tri-service H2 Network

10 Hydrogen Fuel Cell Vehicle

U.S. Army Aloha Microgrid 2

Hybrid Hydrogen Vehicle

Grid

H2 Station Schofield

Fuel Cell Vehicle

Hydrogen Fuel Cell Electric Power Take Off vehicles (EPTO)

70 kW Solar

Two 75 kW Diesel Generators

DC

Energy Storage

Building Loads

2 Plug-in, Bi-directional Electric Vehicles;

2004

Created the H2ICE network and tested

2008

Existing CONUS vehicles arrive in Hawaii

2009

Hybrid Hydrogen Vehicles; In operation in Hawaii since February 2009

First Hawaii Advanced Vehicle Working Group Meeting Held

2010

Microgrid Planning Begins at Wheeler Army Airfield/Schofield Barracks

U.S. Army Aloha Microgrid 1; In operation in November

2011

FCV deployed to Hawaii

General Motors Fuel Cell Vehicles; In Operation Starting August 2011

EPTO used by Marines in August 2011

2012

SPIDERS JCTD

TARDEC Hydrogen Station; Planned operational for March 2012

U.S. Army Aloha Microgrid 2; Planned operational for January 2012

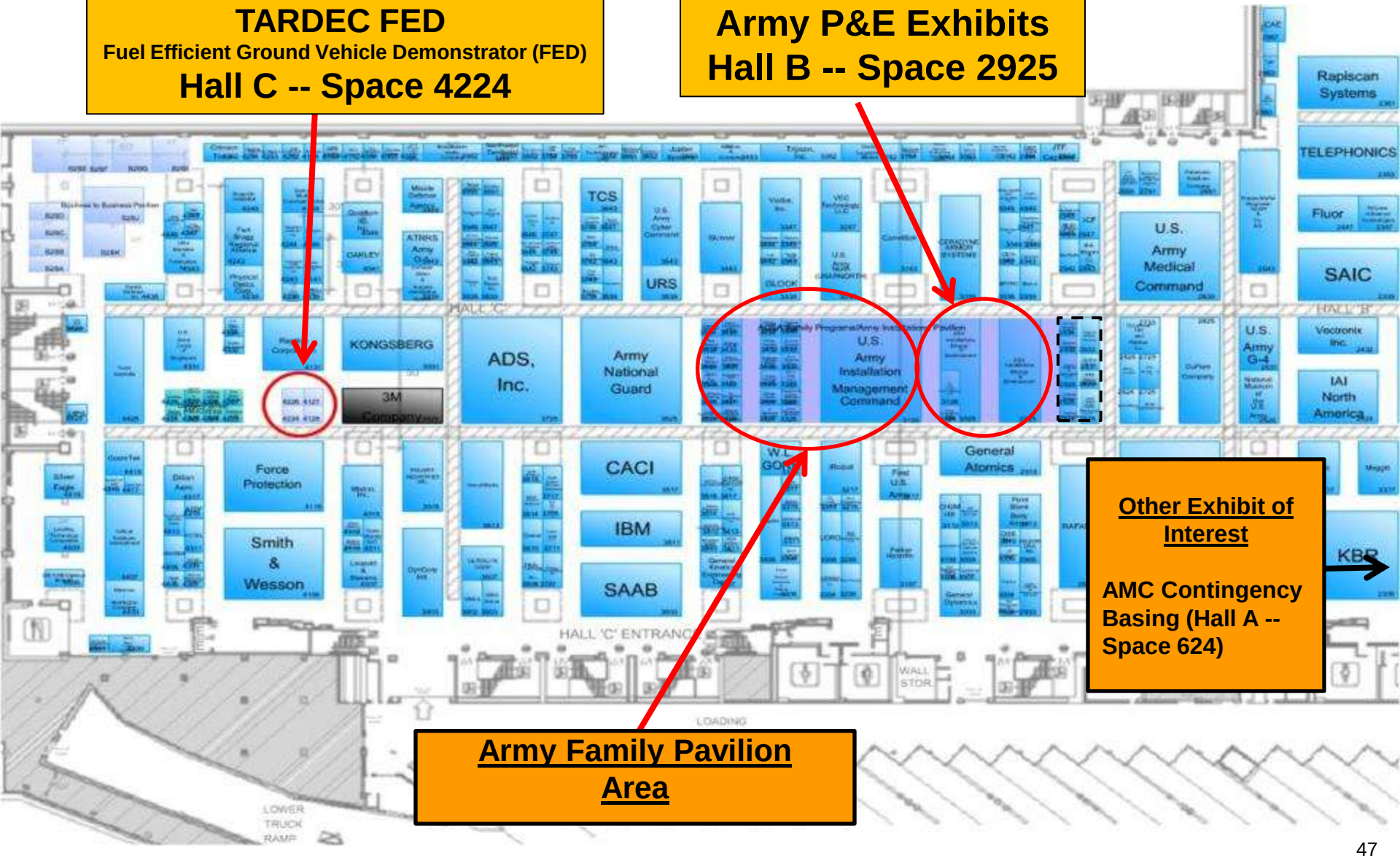
It’s All About the Warfighter

TARDEC’s Ground Vehicle Gateway
https://tardec.groundvehiclegateway.com

Army Power & Energy & Other Exhibits of Interest

TARDEC FED
Fuel Efficient Ground Vehicle Demonstrator (FED)
Hall C -- Space 4224

Army P&E Exhibits
Hall B -- Space 2925

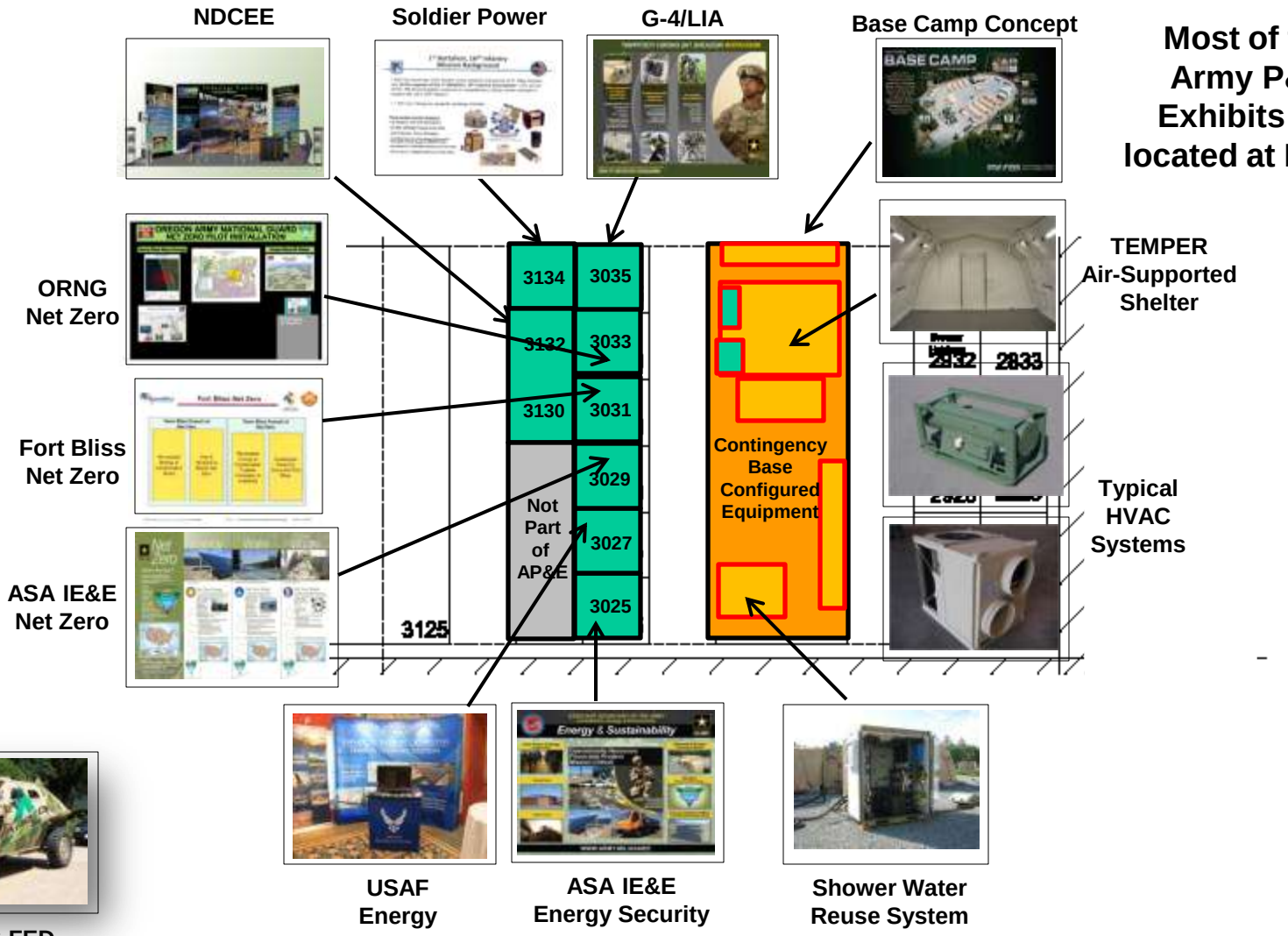


Other Exhibit of Interest

AMC Contingency Basing (Hall A -- Space 624)

Army Family Pavilion Area

AUSA 2011: Army P&E Exhibit Layout – Halls B & C



Most of the Army P&E Exhibits are located at Hall B

TARDEC FED
Hall C -- Space 4125

Army Power & Energy ILW Panel

"Army Power & Energy:
Enhancing Mission Effectiveness, While Preserving Future Choices"
11 October 2011, 1000-1200, Room 152A/B

Distinguished Panel Members include:

Ms. Katherine Hammack
Assistant Secretary of the Army for Installations, Energy & Environment

MG Al Aycock
Director of Operations, Assistant Chief of Staff for Installation Management

MG Dana J. H. Pittard
Commanding General, Fort Bliss, Texas

MG Raymond V. Mason
Assistant Deputy Chief of Staff, G-4

MG Nikolas "Nick" G. Justice
Commanding General, US Army Research , Development & Engineering Command

Dr. Grace M. Bochenek
Director, US Army TARDEC

Closing Comments by:

Mr. Richard Kidd
Deputy Assistant Secretary of the Army for Energy & Sustainability &
Senior Energy Executive, OASA (IE&E)

ARMY STRONG.