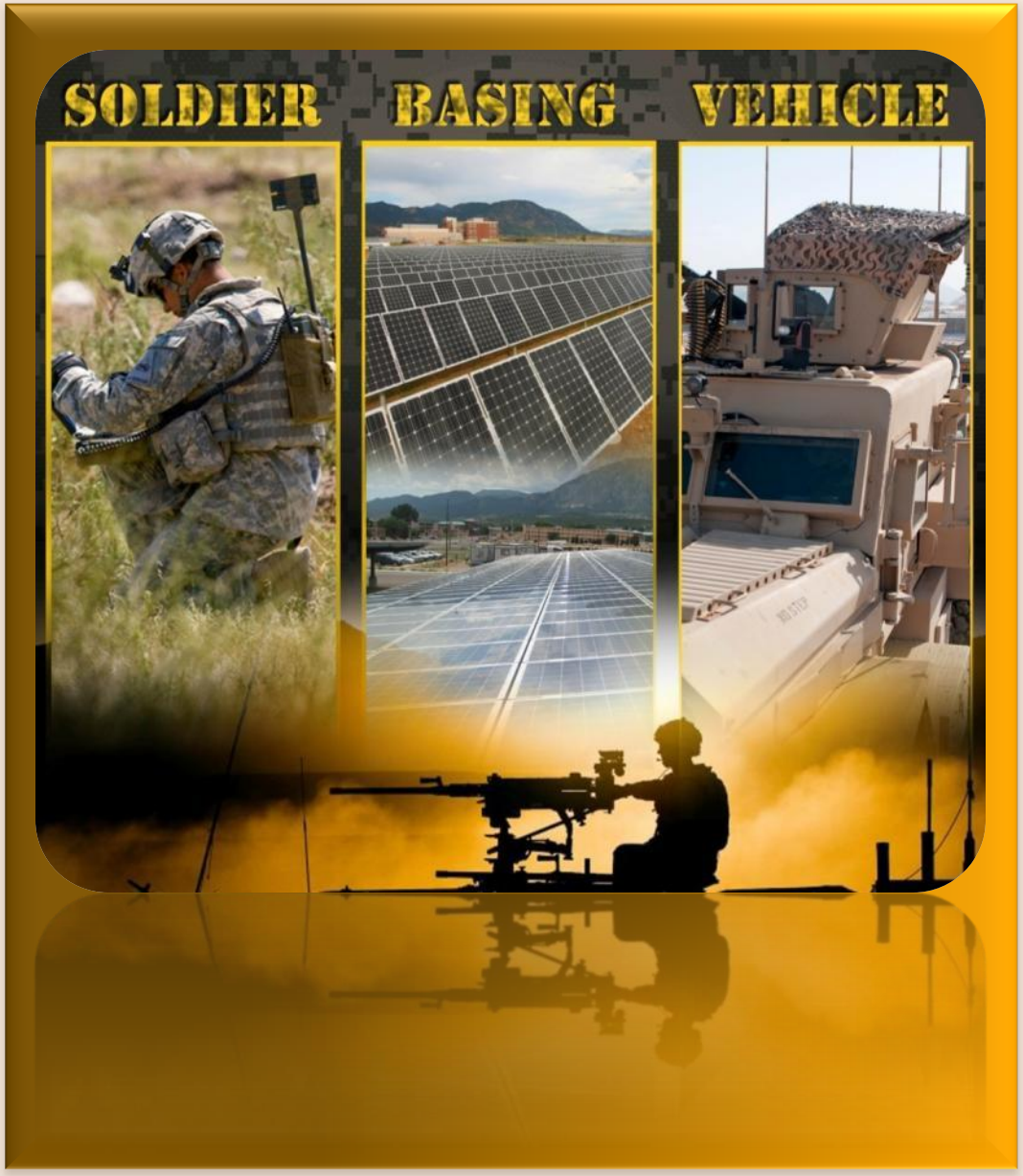
Army Power and Energy



Deputy Assistant Secretary of the Army, Energy and Sustainability

Mr. Richard Kidd

Strategic Context

***Energy Security** is defined as "having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet mission essential requirements."**

- The Army has historically undervalued energy and energy security
  - Evolving from a framework that viewed resource considerations as constraints on operational effectiveness to a perspective that considers the critical role of resources as mission enablers
- Treating energy as a "free good" (unintentionally) creates vulnerabilities and risks
- Energy is a vulnerability that can be exploited and energy shortfalls can increase mission risk
- A ready and resilient Army has secure access to energy, which allows it to act in a complex and rapidly evolving world

"Maintaining our tactical and strategic edge heavily depends upon the wise use of our resources — energy, water, and land — to preserve future choices through superior knowledge, technologies, and execution."
– ES² Strategy, May 2015

*FY 2012, NATIONAL DEFENSE AUTHORIZATION ACT (NDAA)

Drivers of Change

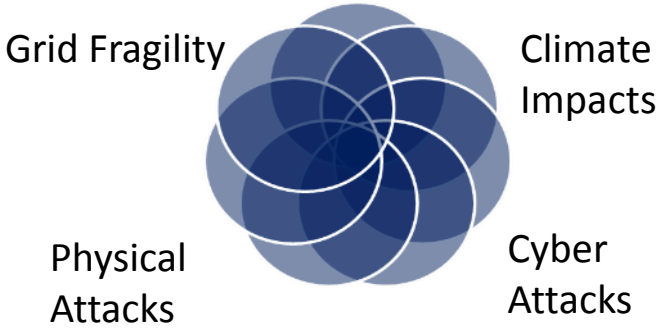
Increased Opportunity and Requirement for Installation Resiliency

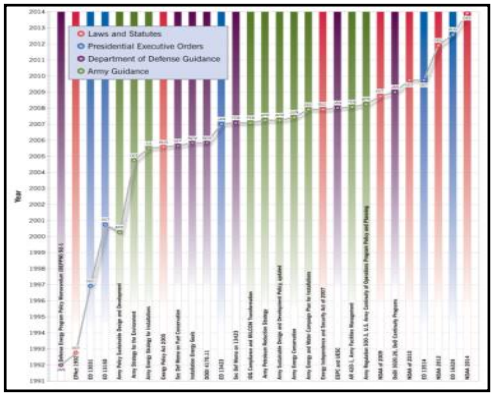
Increasing Requirements

Requirements:

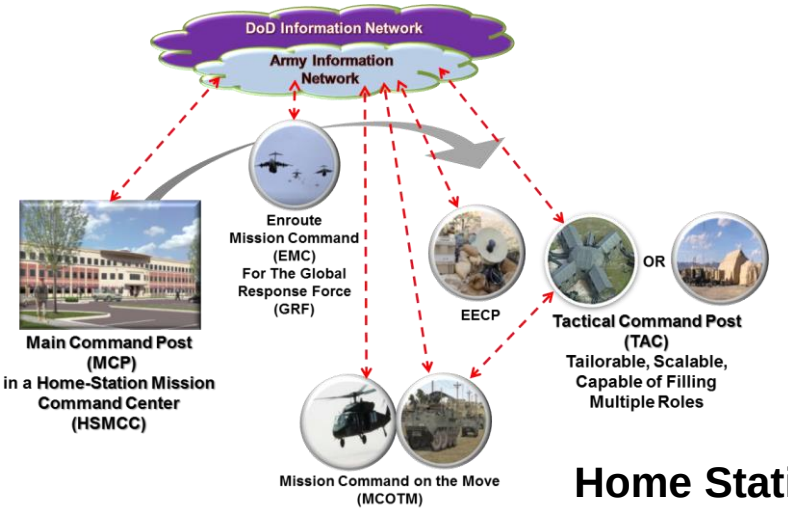
- Increasing operational requirements for CONUS installations (e.g., HSMCC)
- Installations serve as power projection platforms during natural disasters and threats against the homeland
- Legislative and policy requirements

Installation Energy Risk Factors





Legislative & EO requirements continue to increase



Home Station Mission Command Center (HSMCC)

Dynamic Threat Environment

Threats:

- Physical: Increasing trend in power interruptions on Army facilities
- Cyber and Physical Attacks: Risk of cyber attack and attempted physical sabotage
- Climate: Increasing extreme weather events like Hurricane Katrina, Superstorm Sandy

A power plant in the Crimean region of Ukraine

Police investigate shooting of substation in San Jose

Tornado damages high voltage lines at Redstone Arsenal

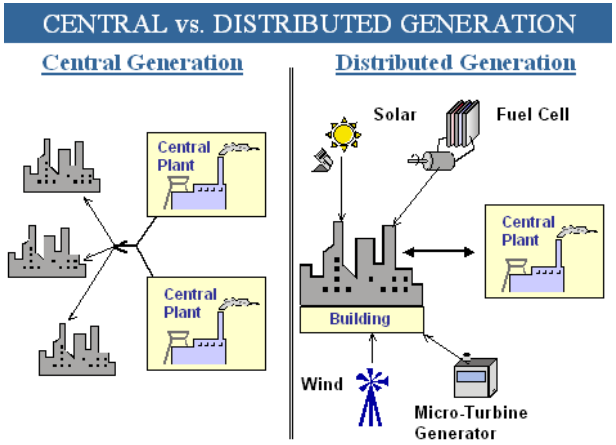
Changing Energy Reality

- Renewables Share of Generation 2000-2015
  - 7 doublings of installed photovoltaic capacity in past 15 years
  - 4 doublings of installed wind capacity in past 15 years

- Decreasing Cost of Energy
  - Onshore wind costs have fallen ~50% since 2009
  - Solar PV module costs have fallen ~80% since 2008
  - Battery storage costs have fallen ~85% since 2008/2009
  - Natural gas costs have fallen ~15% since 2009

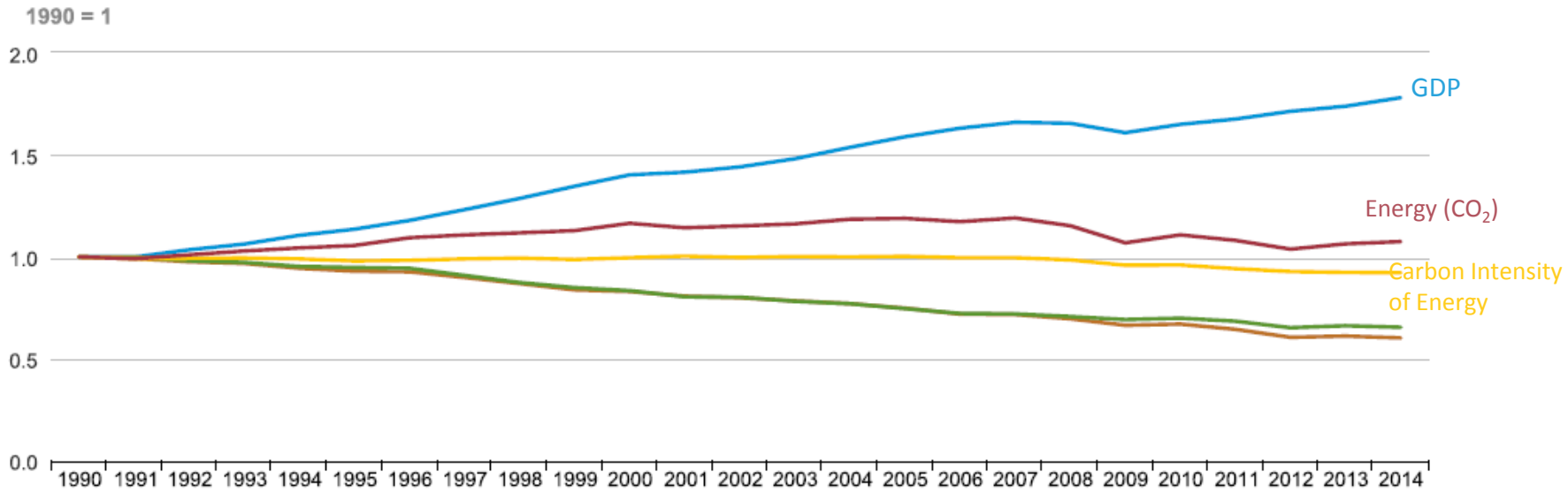
- Fusion of IT with ET

- Transition to Distributed Energy Resources



Changing Energy Reality

Index of Key Energy-Related Emissions Drivers



GDP is increasing, but energy consumption remains flat

Source: EIA October 2015 Monthly Energy Review

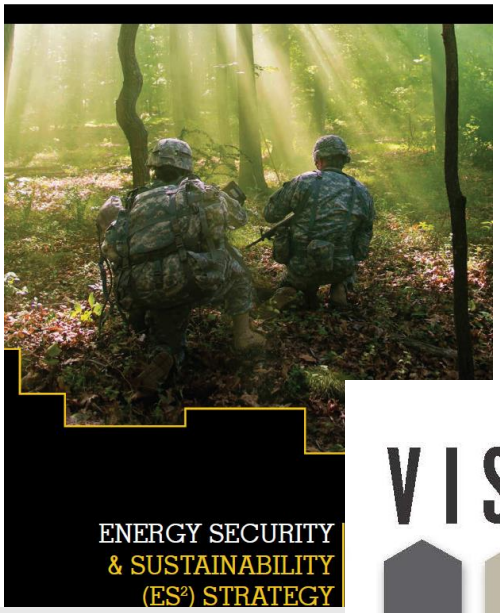
ES² Strategy

Purpose: The ES² Strategy is designed to explain the Army's energy and sustainability posture and establish the underlying basis for an Army that adopts "security," "resiliency," and "future choice" as organizing approaches

Vision: A ready and resilient Army strengthened by secure access to the energy, water, and land resources in order to preserve future choice in a rapidly changing world

Task:

- Replace the 2009 Army Energy and Sustainability Implementation Strategy (AESIS)
- Integrate energy security and sustainability into a resiliency framework
- Expand Army-wide awareness of energy and sustainability concepts, leading to energy-informed decision making



Army Energy Security & Sustainability Strategic Goals

1. Inform Decisions
2. Optimize Use
3. Assure Access
4. Improve Resiliency
5. Drive Innovation

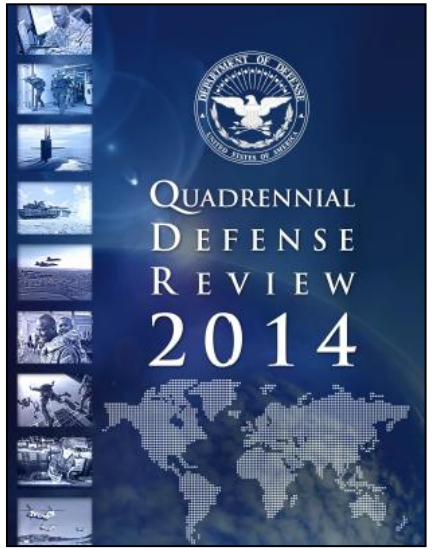
2014 QDR & Climate Change

- "The impacts of climate change may increase the frequency, scale, and complexity of future missions, including defense support to civil authorities, while at the same time undermining the capacity of our domestic installations to support training activities." (pg. vi)

- "Climate change poses another significant challenge for the United States and the world at large. … These effects are threat multipliers that will aggravate stressors abroad such as poverty, environmental degradation, political instability, and social tensions…" (pg. 8)

- "Finally, the Department will employ creative ways to address the impact of climate change, which will continue to affect the operating environment and the roles and missions that U.S. Armed Forces undertake." (pg. 25)

- "We will complete a comprehensive assessment of all installations to assess the potential impacts of climate change on our missions and operational resiliency, and develop and implement plans to adapt as required." (pg. 25)



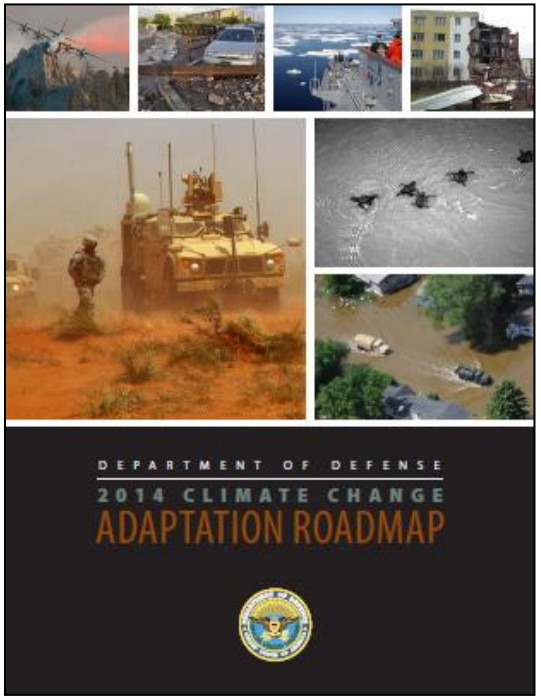
http://www.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf

Climate Adaptation Roadmap

2014 DoD Climate Change Adaptation Roadmap

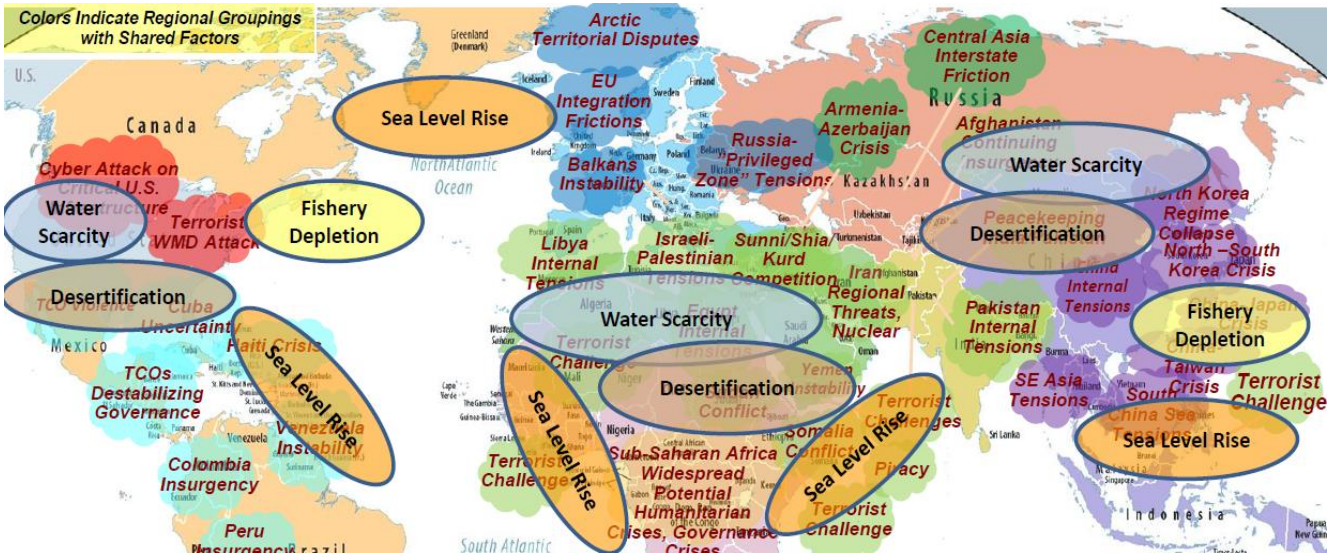
- Required under EO 13653
- Four Lines of Effort set enterprise-wide approach:

1. Plans & Operations
2. Training & Testing
3. Built & Natural Infrastructure
4. Acquisition & Supply



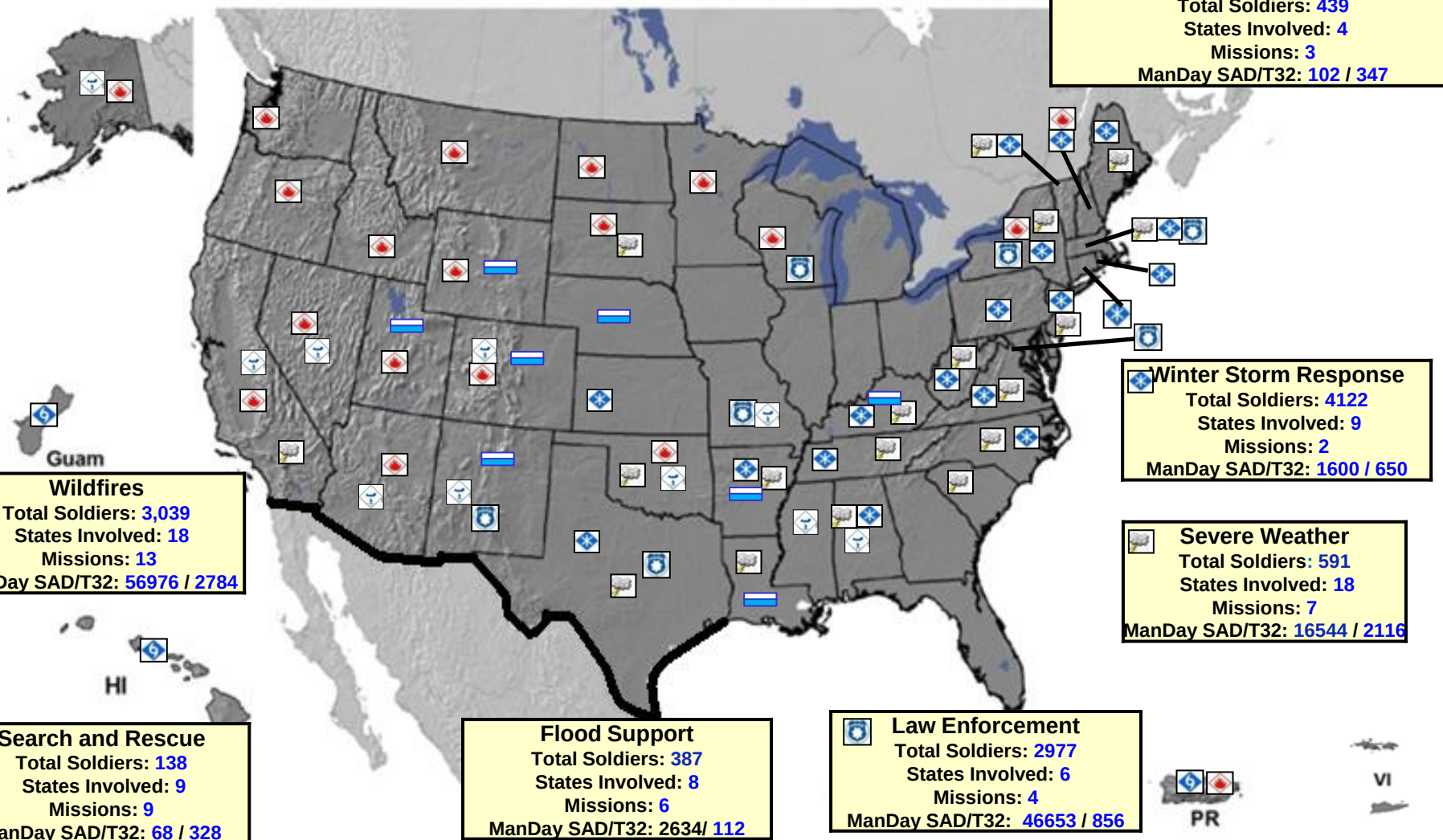
LOE 1: Plans and Ops

The effects of climate change will drive weak governance & accelerate other megatrends



Demand for disaster response & humanitarian assistance missions is expected to increase

LOE 1: Plans and Ops



Hurricane/ Tropical Storm Support
Total Soldiers: 439
States Involved: 4
Missions: 3
ManDay SAD/T32: 102 / 347

Winter Storm Response
Total Soldiers: 4122
States Involved: 9
Missions: 2
ManDay SAD/T32: 1600 / 650

Severe Weather
Total Soldiers: 591
States Involved: 18
Missions: 7
ManDay SAD/T32: 16544 / 2116

Wildfires
Total Soldiers: 3,039
States Involved: 18
Missions: 13
ManDay SAD/T32: 56976 / 2784

Search and Rescue
Total Soldiers: 138
States Involved: 9
Missions: 9
ManDay SAD/T32: 68 / 328

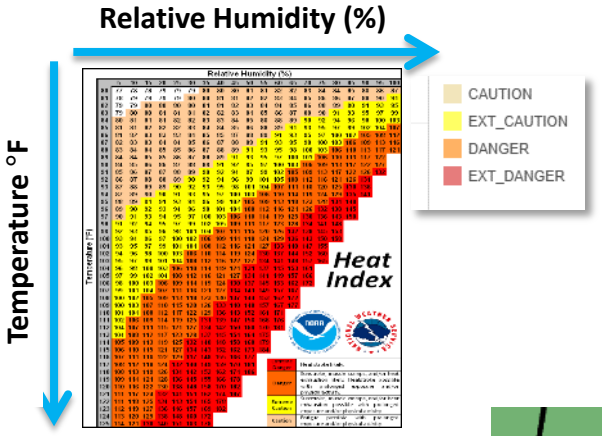
Flood Support
Total Soldiers: 387
States Involved: 8
Missions: 6
ManDay SAD/T32: 2634/ 112

Law Enforcement
Total Soldiers: 2977
States Involved: 6
Missions: 4
ManDay SAD/T32: 46653 / 856

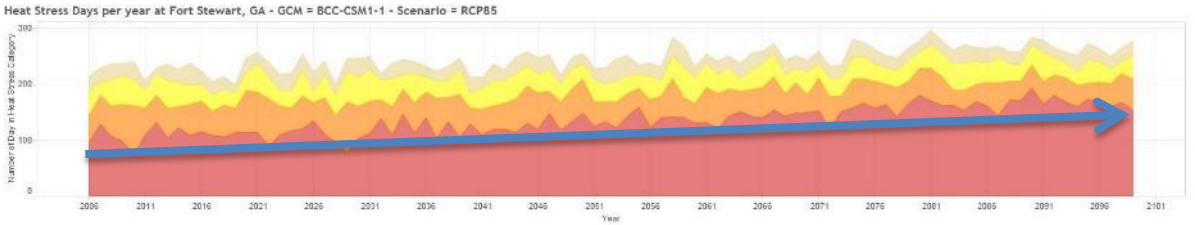
LOE 2: Training & Testing

FORT
HWEST
GREAT PLAIN
CAMP
WILLIAMS
CAMP PARKS
FORT HUNTER LIGGETT
CAMP ROBERTS
FORT CARSON
SOUTHW
FORT
RILEY
FORT
LEAVENWORTH
CAMP
GRAYLING
NGTON
GHTS
CAMP
ATTERBURY
MIDWEST
Fort
Indiantown
Gap
FORT
A.P
FORT KNOX
FORT
CAMPBELL
FORT BRAGG
SOUTHEAST
BIRMINGHAM
FORT S
CAMP SHELBY
CAMP BLANDING
FORT HOOD
HOUSTON
OCONUS Locations
OCONUS MTCs
USAEUR Shell Locations
USAR MTC Locations
ARNG MTC Locations
ARNG Installations
Active Component Installations
USAR Installations
Co-RCTC Capability
FORT WAINWRIGHT/
DONNELLY TA
ALASKA
FORT
RICHARDSON
HAWAII
SCHOFIELD
BARRACKS
PTA

Training & Heat Stress

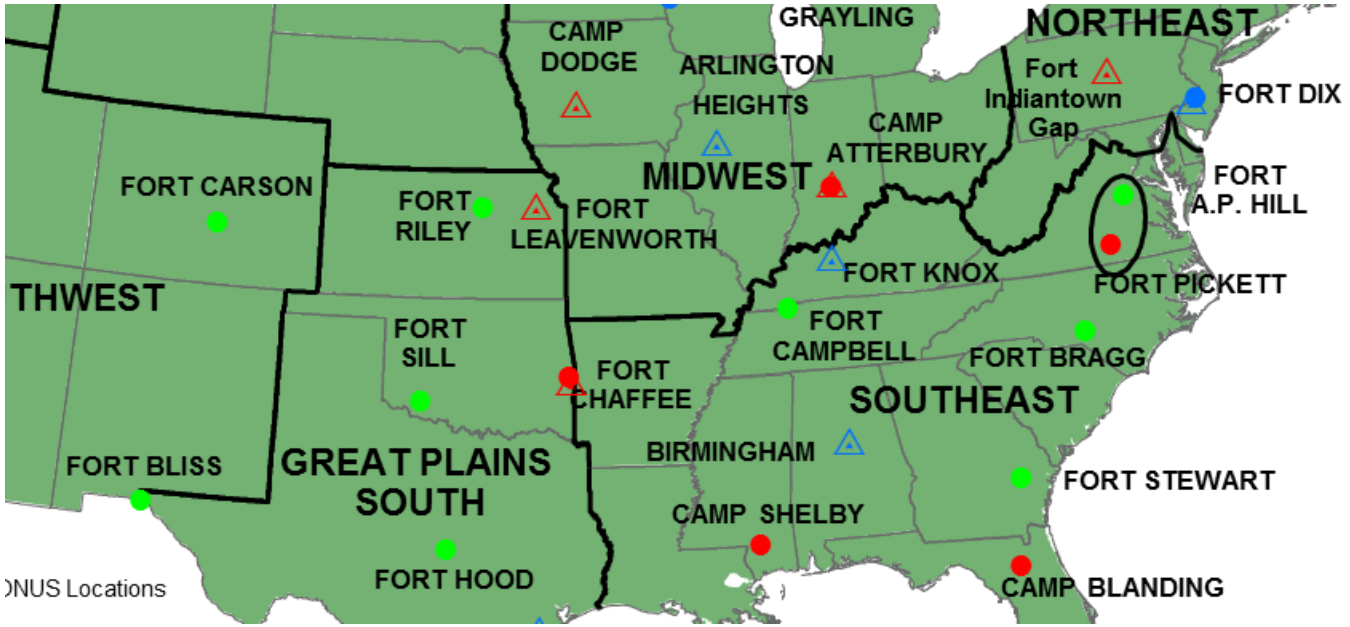


can be translated into the Army Wet Bulb Globe Temperature categories



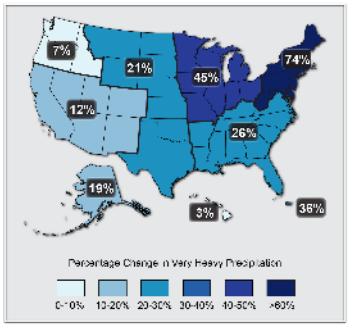
2010
~80 days/yr

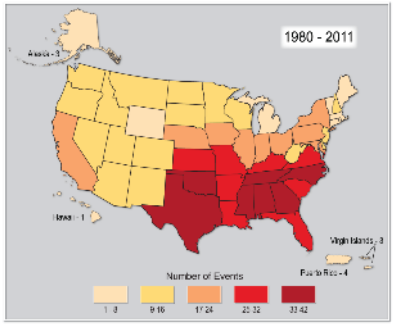
2100
~135 days/yr

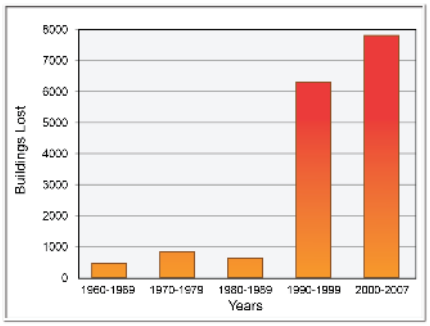


LOE 3: Built & Natural Infrastructure

National Climate Assessment:







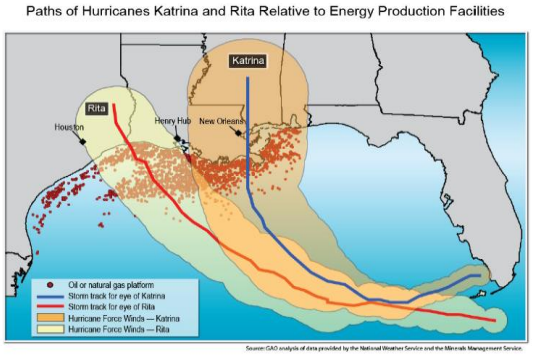
Ft Jackson, Oct 2015: "The weather forced us to cease daily operations, close schools, coordinate with state government and support local (and federal emergency) response," said R.J. Frazier, Fort Jackson's emergency manager.

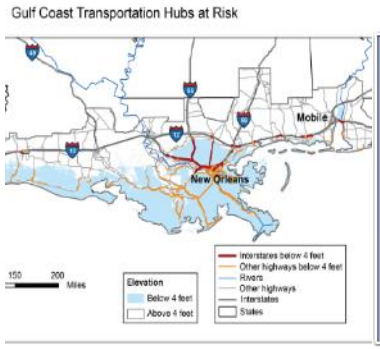
Ft Irwin, Aug 2013: an extreme rainfall event caused severe erosion, washed out roads, & toppled structures & support electronics in the training range, resulting in $64M in damages

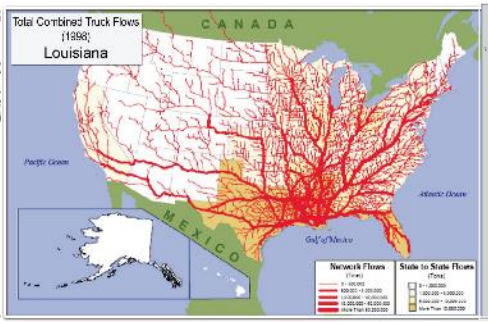
Photo Credit:
Wallace McBride, Fort Jackson Leader

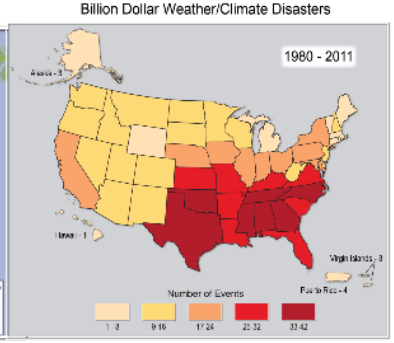
LOE 4: Acquisition & Supply

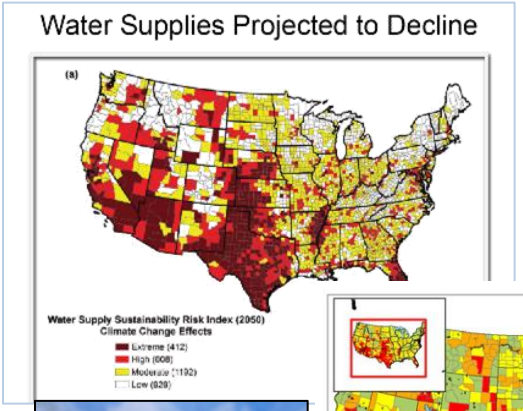
National Climate Assessment

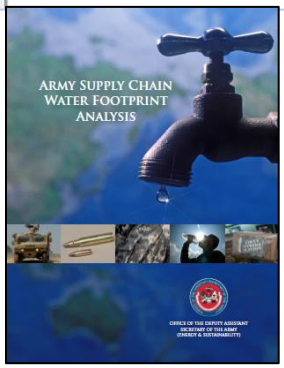












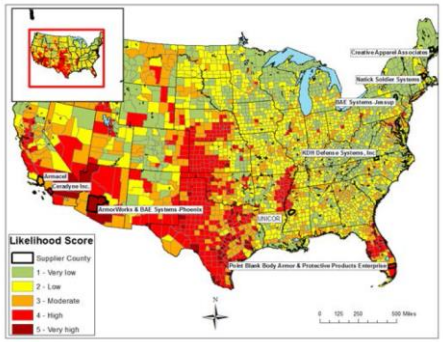


Figure 4: Improved Interceptor Body Armor: Tier 1 and 2 Suppliers and Water Supply Disruption Likelihood in 2050

Prolonged droughts & increased severe weather events:

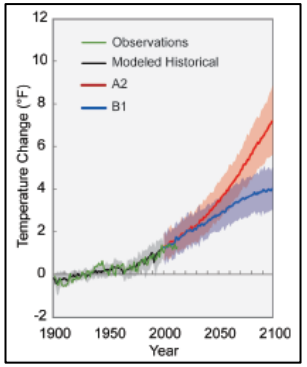
- More frequent production disruptions
- Affects on water-intensive manufacturing
- Disruptions to key transportation modes and routes
- Higher cost of commodities & goods
- Cumulative impact on critical suppliers

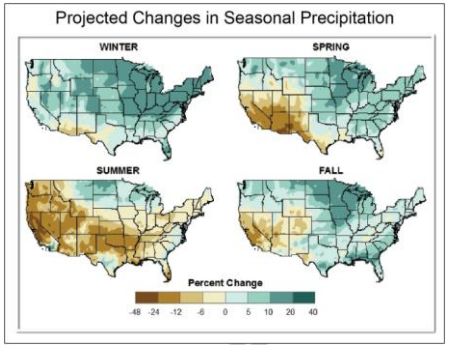
Other Installation Impacts?

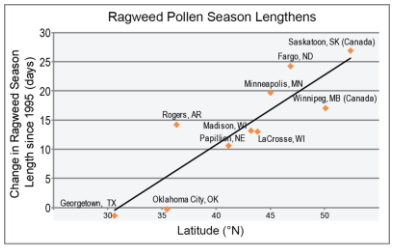
What is the impact of climate change on:

- **Housing & barracks**
  - Mold & air-born pollutants
  - Repair frequency
  - HVAC operations & utility costs
- **CDCs**
  - Landscaping & artificial turf
  - Adequate outdoor shade/cooling
- **Pest management**
  - Shift in species? new species?
  - Extended periods of exposure?
- **Water systems**
  - Maintenance (freeze/thaw; disinfection residual)
  - Regional availability? Outages?
- **Emergency response planning**
  - Increased wildfire risk? severe storms?
- **Natural Resources**
  - Impacts to TES? land management?

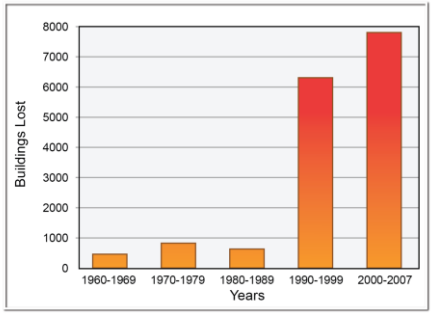
National Climate Assessment:







Building Loss by Fires at California Wildland-Urban Interfaces



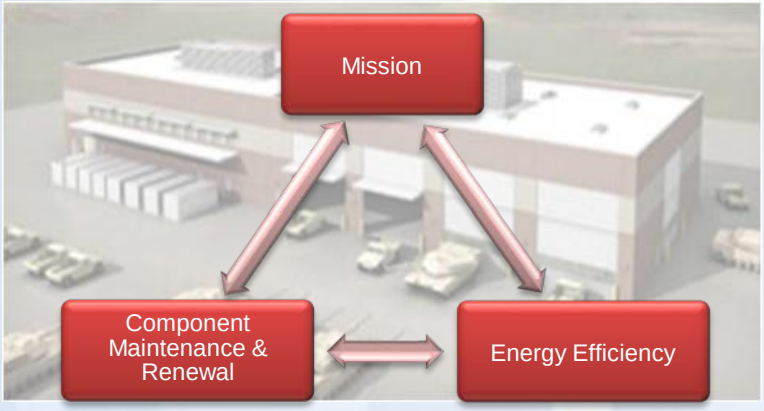
Adaptive & Resilient Installations

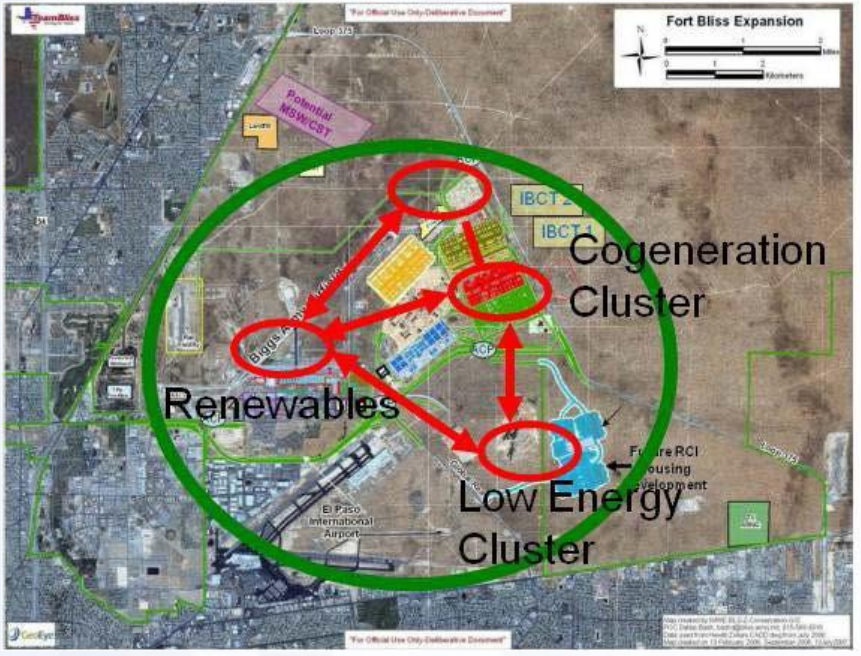
Research and Development of innovative S&T solutions to more efficiently plan, design, construct, operate and maintain installations, including contingency bases

Asset condition prediction- developed condition analysis capability, established science based prediction of maintenance requirements using systematic assessment of condition analysis.

Purpose:

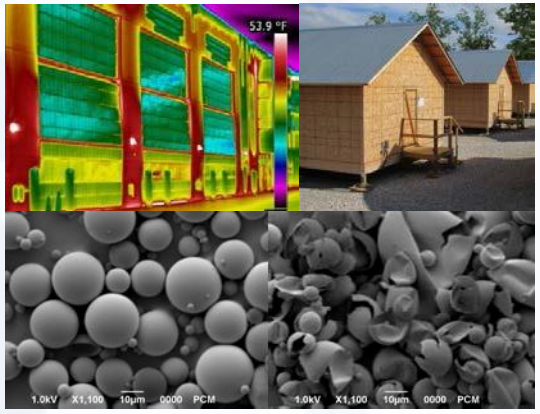
- Increase installation mission readiness
- Increase installation energy and water security, decrease waste, while reducing overall costs and usage rates
- Support highly sustainable installations
- Reduce installation lifecycle costs





Advanced Material Development & Construction Methods

- **Reduce energy losses through building envelopes**



Installations Energy

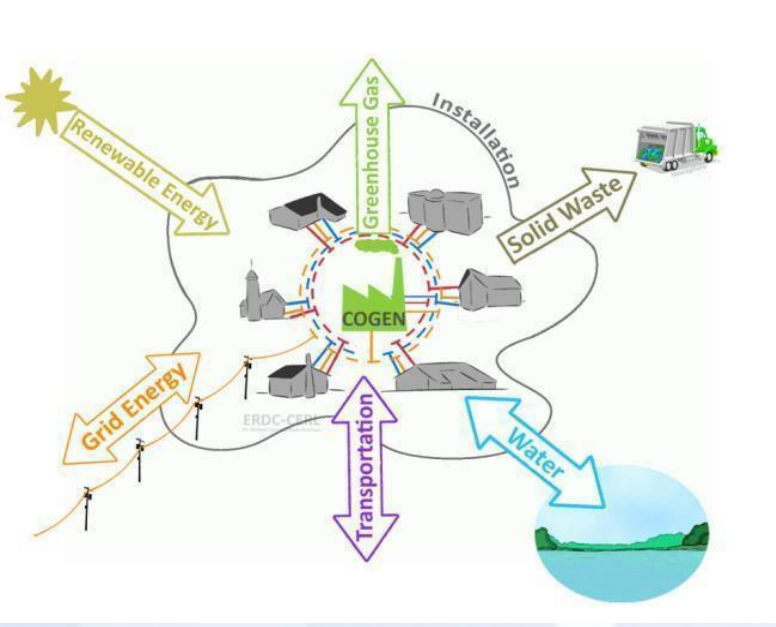
- **Develop mitigation strategies using modeling and advanced materials to meet mandated energy reduction goals**

Advanced Materials

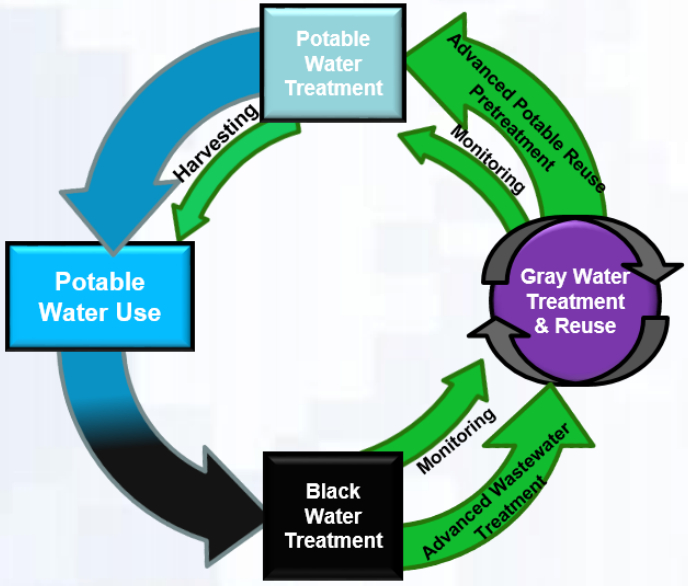
- **Print custom-designed expeditionary structures on-demand, in the field, using locally available materials and a minimum of personnel.**
  - Reduced construction time (4-5 days to 1 day)
  - Reduced construction requirements (8 personnel to 3 personnel per structure)
  - Reduced logistics (materials shipped, personnel and resources to sustain the structures and personnel)
  - Decreased material shipped from out of theater (5 tons to less than 2.5 tons)

Systems-of-Systems Approach for Planning & Operation

- **Integrated modeling to support Installation master planning for Energy, Water, and Waste (EW^2) resource optimization**
  - Reduced energy, water, waste, and GHG to meet Army requirements
  - Integrated approach to management of resources progressing toward net-zero end states
  - Improved local and regional security



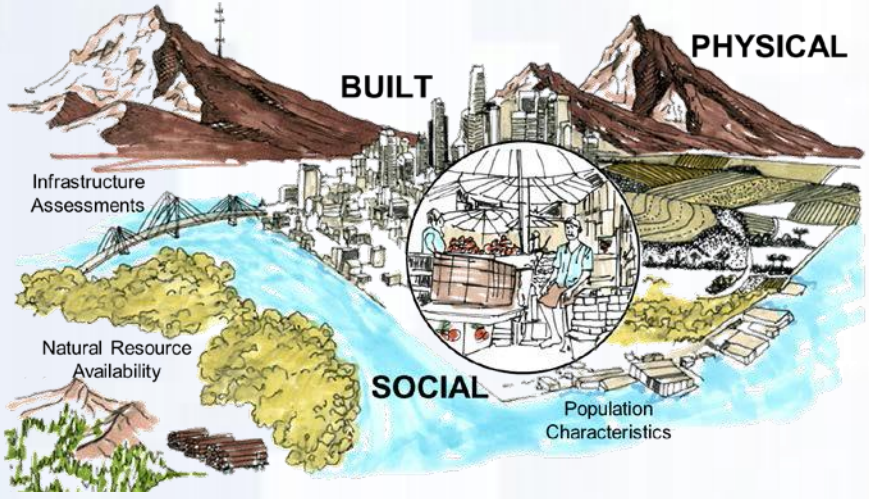
- **Practical/efficient water sustainment technologies enabling maximal water reuse, harvesting, and monitoring at Army CBs**
  - 25% reduction in net water demand
  - $2M/year savings per 1000 PAX base
  - Reduced manpower and energy
  - Increased security



Integrated Planning, Assessment & Design Tools

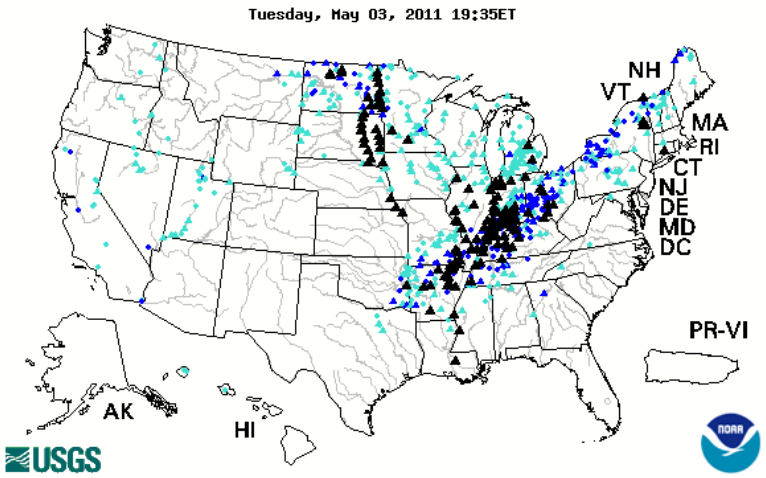
- **Integrated planning, design & analysis toolset for contingency base (CB) camps**
  - Rapid assessment of the serviceability/life cycle sustainability of CB designs
  - Simulates CB operations to identify areas to improve mission effectiveness & efficiency
  - Training tool for personnel (CB design, planning, operations and management activities)
- **Tools to assesses impact of physical, ecological, and sociocultural environments for CB site selection, design, operations and maintenance**
  - Increased mission effectiveness through operational environmental assessment of CB site selection, design, and O&M
  - Reduced logistical burdens through optimal CB site selection and design
  - Improved acceptance by the local population of military presence, CB construction, O&M activities, and transition through consideration of sociocultural values

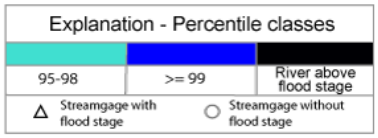
FUNCTION	STATUS	CURRENT	REQUIRED
Potable Water Storage		20,000 gal	17,000 gal
Housing		200 m²	200 m²
Power Generation Capacity		360 kW	420 kW



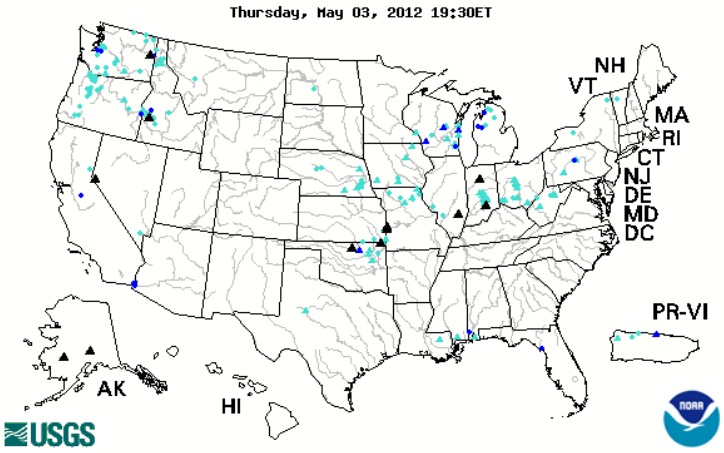
Rapidly Changing Conditions

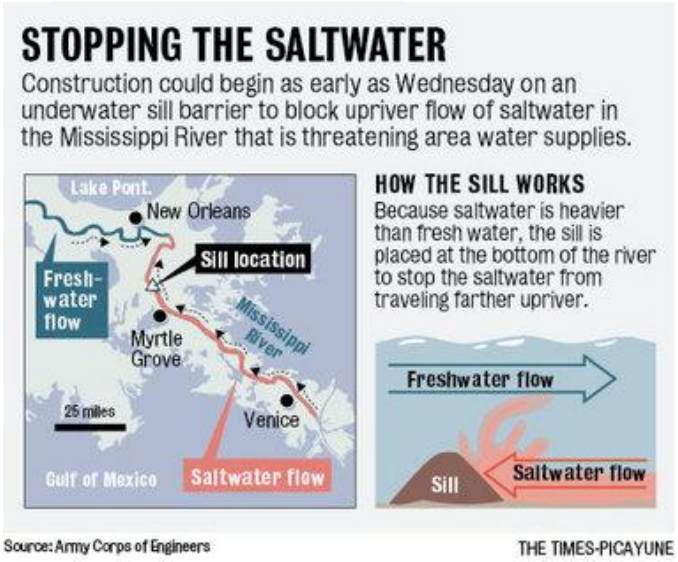
Flooding on the Mississippi River, May 2011





Low Water on the Mississippi River, May 2012





Office of Energy Initiatives

The Army Office of Energy Initiatives (OEI) centrally manages, develops, and executes large-scale renewable energy projects, 10 MW or greater, by leveraging private Financing.

Renewable energy produced on Army installations increases energy security and enhances mission effectiveness.

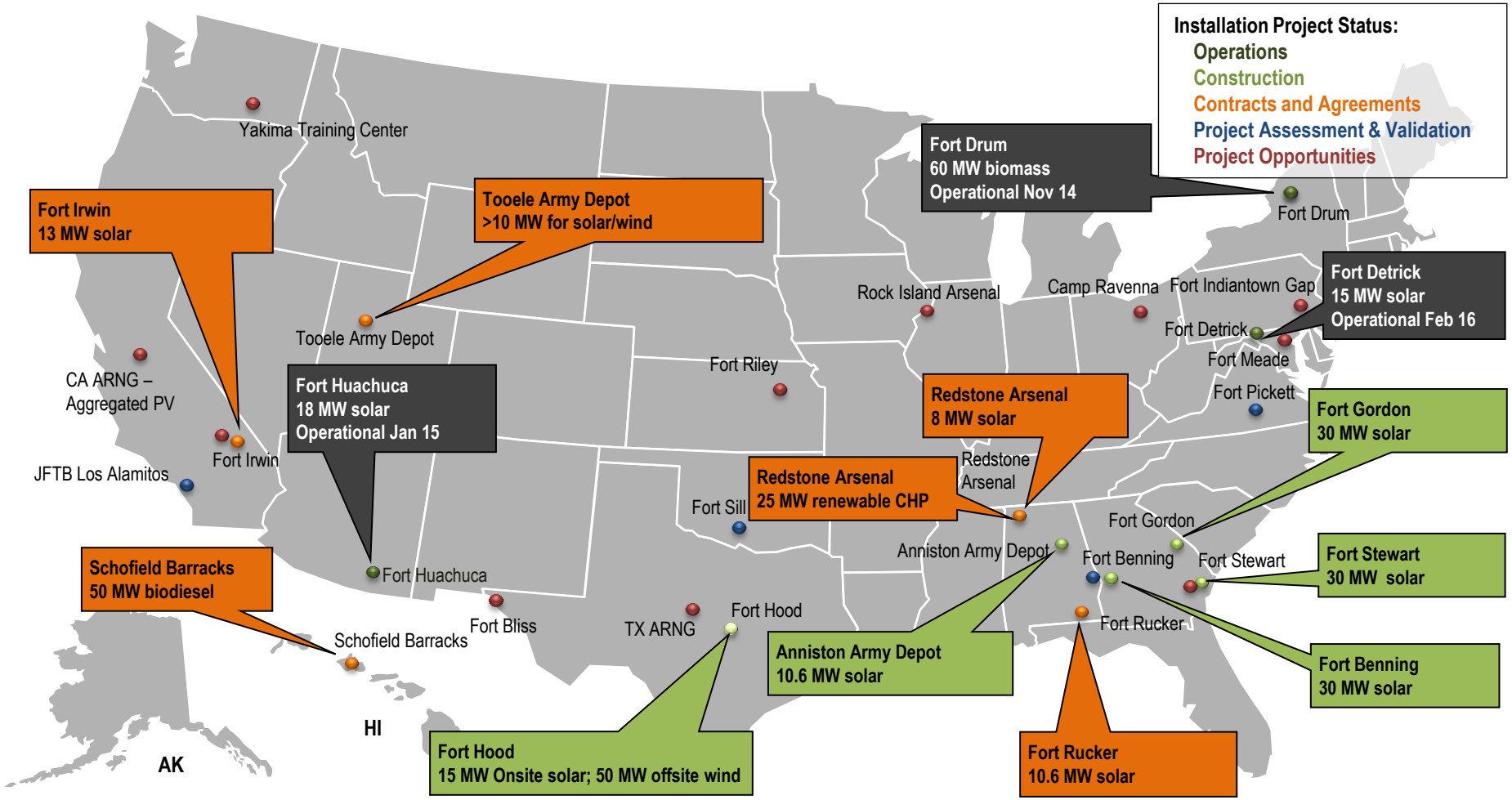
28 MW Biomass Plant
Fort Drum, NY, Feb 2014

65 MW Hybrid Solar and Wind Project, Fort Hood, TX, Groundbreaking Jan 2016

30 MW Solar Array, Fort Benning GA, Jan 2016
>133,000 Solar Panels

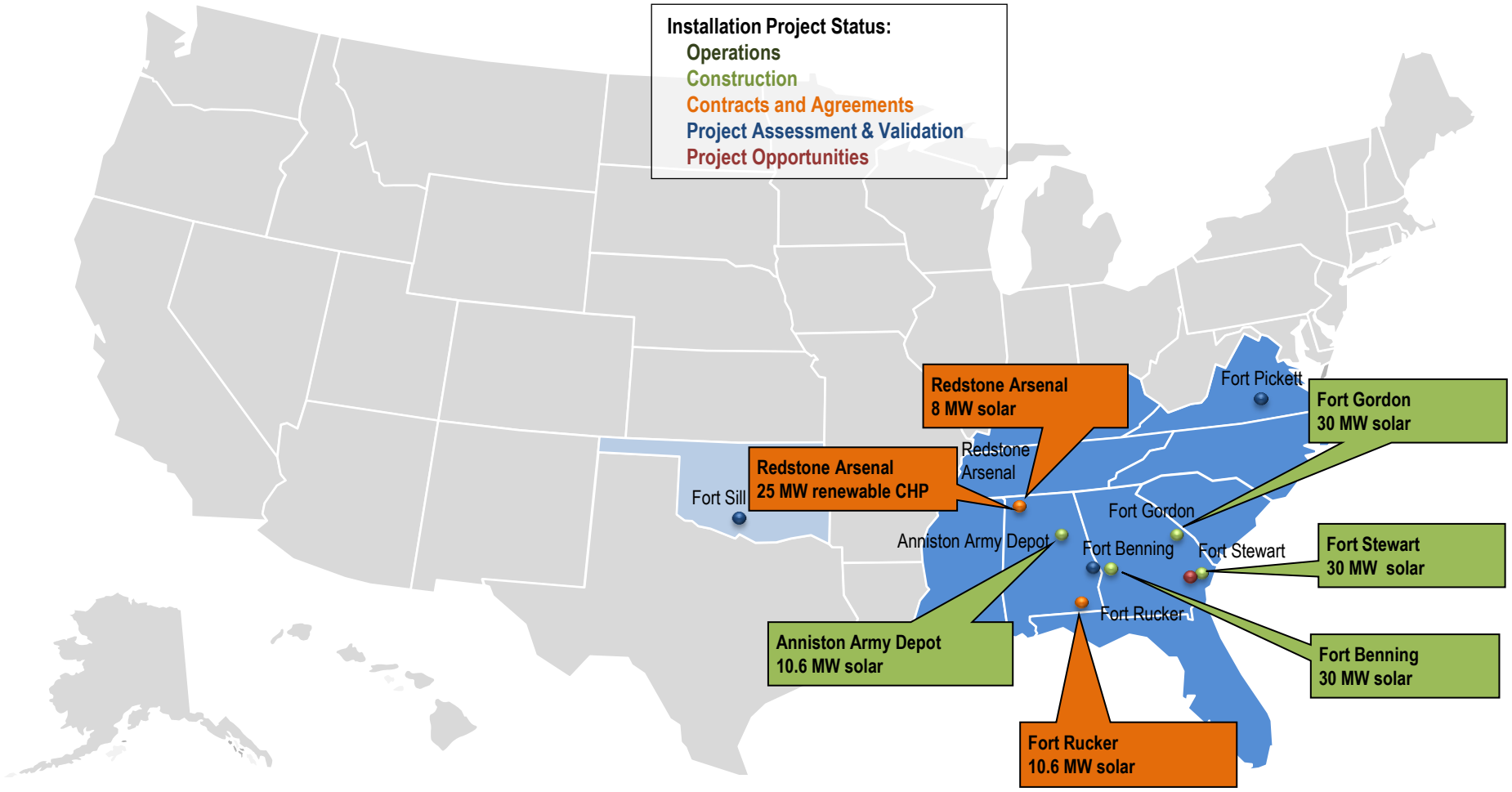
Good for the Army, Good for Industry, Good for Communities

Army Large-Scale RE Projects



Increasing Energy Security and Resiliency Across Army Installations

Army on the Geographic Frontier of U.S. Renewable Energy Market

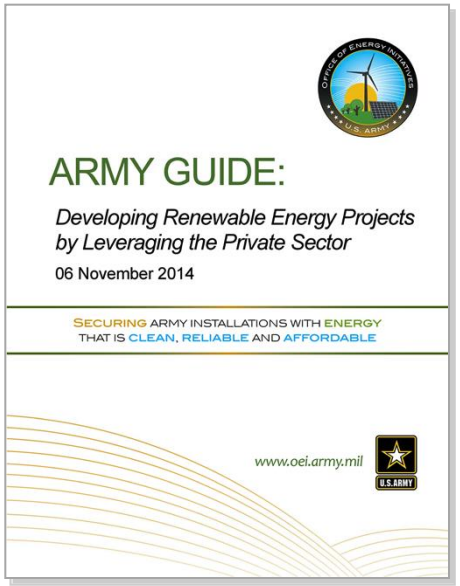


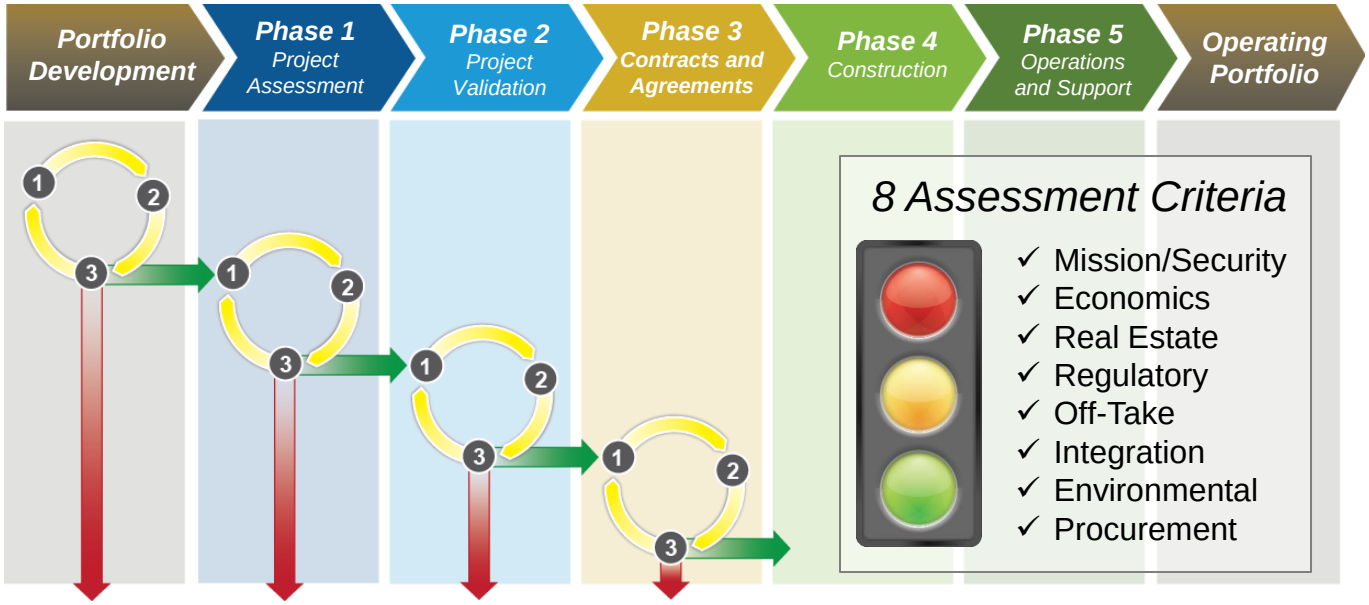
Solar projects at Ft. Gordon, Ft. Stewart, and Ft. Benning (~90 MW) have **TRIPLED** PV capacity in Georgia

Iterative RE Development

The Army Guide outlines the approach and processes for project development

- The development and due diligence process can be used across each of the early phases of the lifecycle
- Projects should be analyzed using the 8 Assessment Criteria and evaluated for viability
- Projects with sufficient viability to justify increased investment should be moved forward; those that are not viable should be suspended





Example - Fort Hood

FORT HOOD 15 MW Solar and 50 MW Wind

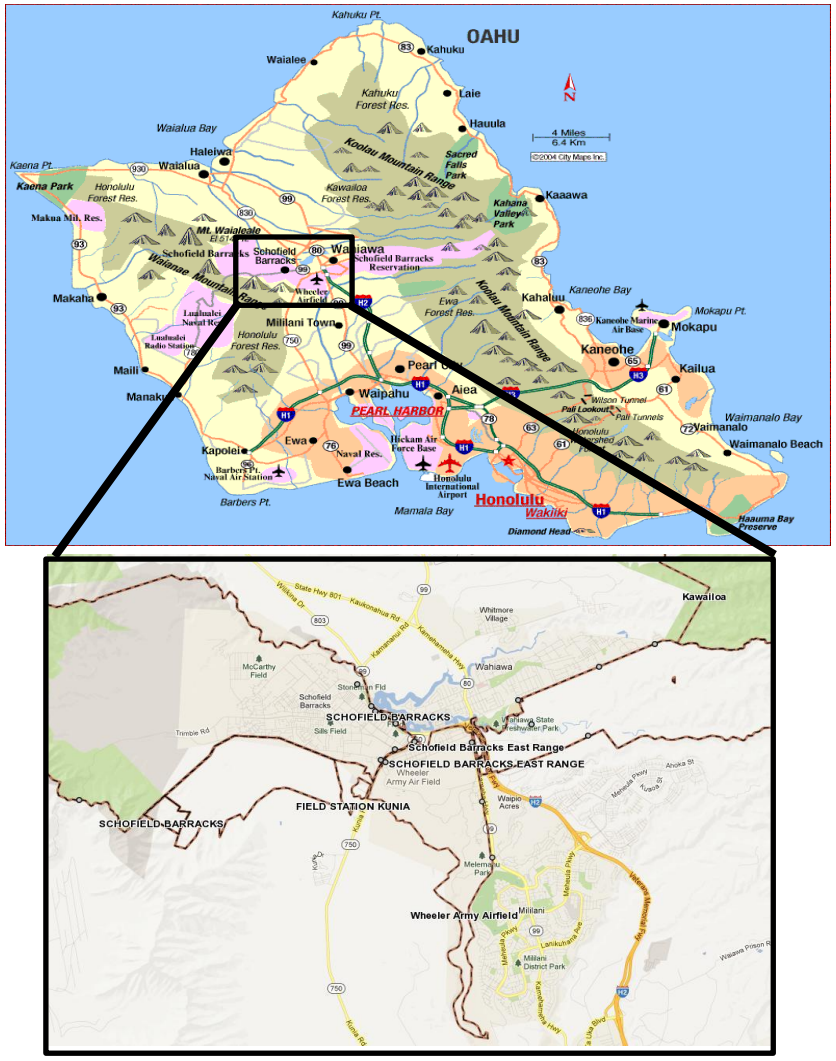
- Army's first hybrid (solar and wind AC) renewable energy project
- Army's first project to include both on and off installation generation
- Army's largest single renewable energy project to date
- Provides long term price stability and reduces price risk
- $168 Million in projected present value cost avoidance for Army over life of contract
- Brings in more than $1 million in fair market rental revenue over the 30 year term
- Over the life of the contract the project is expected to deliver at least 30% cost savings from the conventional rate

Example - Fort Drum

FORT DRUM 60MW Biomass

- Biomass Generation Facility (BGF) supplies 100% of garrison's electricity
- The system operates independent of the local utility, National Grid
- Fort Drum's electricity supply and consumption are not affected by outages National Grid may experience
- Should the BGF go offline, Fort Drum's substations automatically revert to taking electricity from National Grid

Example - Schofield Barracks



- Army is providing land at Schofield Barracks for Hawaiian Electric to construct, own, operate and maintain a 50 MW biofuel-capable power generation plant
- As consideration for the lease, Hawaiian Electric will give the Army "first call" on the electricity it produces during sustained outages or security threats
- 50 MW of firm power is sufficient to meet the peak electricity requirements at Schofield Barracks, Wheeler Army Airfield, and Field Station Kunia
- Ensures that Army critical national security and first response missions can be carried out even when the island wide utility grid has been compromised
- Energy security benefits extend beyond Army
  - Shortens the time required to restore power to the surrounding community
  - Provides capability and capacity to start up other Hawaiian Electric generation units

Resilient Contingency Bases

- Integrated and Distributed Technologies
  - Critical Systems Remain operational in the face of disruptive events
  - Flexible and Diverse Capabilities
  - Adaptability to Uncertain and Changing Conditions
  - Reduced Resource Resupply Burden

Improved Efficiency Space Heater

Black Waste Remediation

Results measured as increased capability, reduced vulnerability, and dollars saved

Distributed Renewable Generation

Energy Efficient Shelters

Operational Energy Savings

Before	After	Results
VSP LAM/COP GIRO • Multiple Generators running at sub-optimal levels • Generator wetstacking • High Generator Maintenance • Resupplied by airdrop (LAM), Sling Load (GIRO) • Significant equipment and manpower requirement for resupply	**VSP LAM/COP GIRO** • Balanced generator with loads to remove excess generators • Installed hybrid energy solutions to meet energy demands of mission critical systems • Improved reliability of supply • Provided OE Subject Matter Expertise to Leaders & Soldiers	**VSP LAM** • Reduced fuel consumption 120 Gallons per Day (GPD) • Reduced # of Generators online 60% • Enhanced mission effectiveness **Savings: - ROI 6 months** • FBCF: $12.60 • Fuel: 43,800 Gal • Dollars: $551,880 • Equipment: 25 (C17) Flight Hours • Soldier: 228 Man-Hours **COP GIRO** • Reduced fuel consumption 107 GPD • Reduced # of Generators online 40% • Enhanced mission effectiveness **Savings: - ROI 4 months** • FBCF: $20.38 • Fuel: 38,520 Gal • Dollars: $785,037.60 • Equipment: 216 (UH60) Flight Hours • Soldier: 1771 Man-Hours

POTENTIAL IMPACTS OF OE INVESTMENTS ACROSS ALL OF AFGHANISTAN

- 6.2 M gallons fuel ->$107,000,000 -> 160,000 man hrs - > 63,000 gen hrs > 15,000 C-17 hrs - > 190,000 UH-60 hrs - near total readiness for sensitive electrons

Resilient Soldiers

- Lightweight Soldier power solutions intended for the most austere operating environments
  - Reduce Soldier Load (Extended patrol time) and Increased Lethality
  - Increased Use of Rechargeable Batteries
  - Reduced Sustainment Requirements
  - Increased Logistics Readiness and Operational Effectiveness

Working With the Army

- **ASA(IE&E): http://www.asaie.army.mil/ ACSIM: http://www.acsim.army.mil/ USACE: http://www.usace.army.mil/**
- **Renewable Energy on Army Lands**
  - Large Scale Renewable Energy Projects (>10MW): http://www.asaie.army.mil/Public/ES/oei/
  - Siting Clearinghouse: http://www.acq.osd.mil/dodsc/
- **Science and Technology**
  - Army Acquisition Business Website: https://acquisition.army.mil/asfi/
  - Base Camp Integration Laboratory: https://pmfss.natick.army.mil/
  - Communications-Electronics Research, Development and Engineering Center: http://www.cerdec.army.mil/business/index.asp
  - Natick Soldier Research, Development and Engineering Center: http://nsrdec.natick.army.mil/business/index.htm
  - National Defense Center for Energy and Environment: http://www.ndcee.ctc.com/
  - Network Integration Evaluation: http://integration.army.mil/
  - Rapid Equipping Force: http://www.ref.army.mil/
- **Facilities Energy Innovation**
  - Net Zero: http://www.asaie.army.mil/Public/ES/netzero/
  - Strategic Environmental Research and Development Program (SERDP) & Environmental Security Technology Certification Program (ESTCP): http://www.serdp.org/
  - Energy Security and Sustainability (ES2) Strategy: http://usarmy.vo.llnwd.net/e2/c/downloads/394128.pdf
- **Vehicle Innovation**
  - Tank Automotive Research, Development and Engineering Center: http://www.army.mil/tardec
  - Aviation & Missile Research, Development & Engineering Center: http://www.redstone.army.mil/amrdec/Business/index.html
- **Small Businesses**
  - Army Small Business Innovation Research Program: https://www.armysbir.army.mil/sbir/Default.aspx