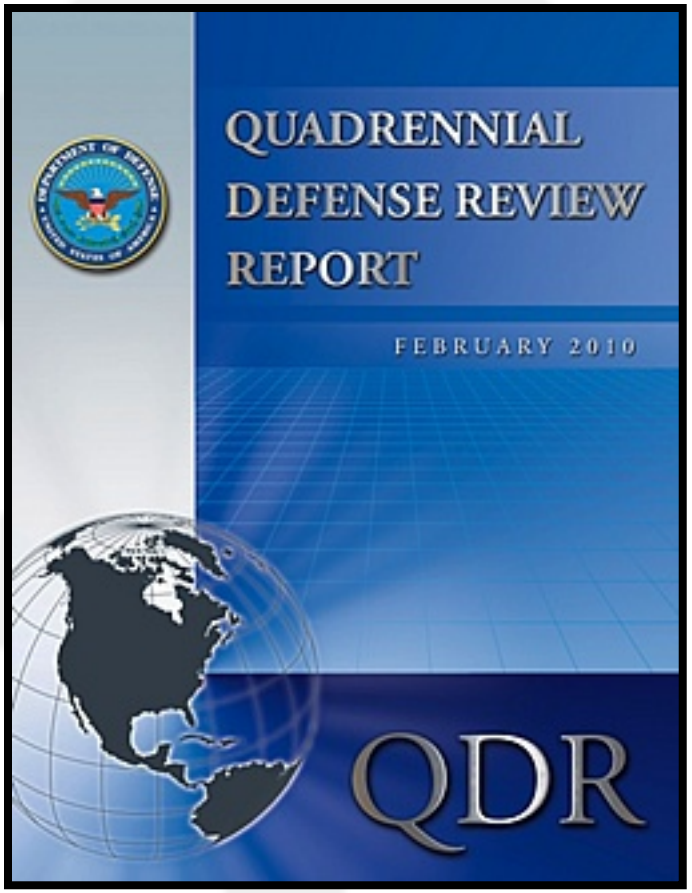
Leading By Example

The US military's efforts to develop renewable and clean energy sources to power our forces and combat climate change

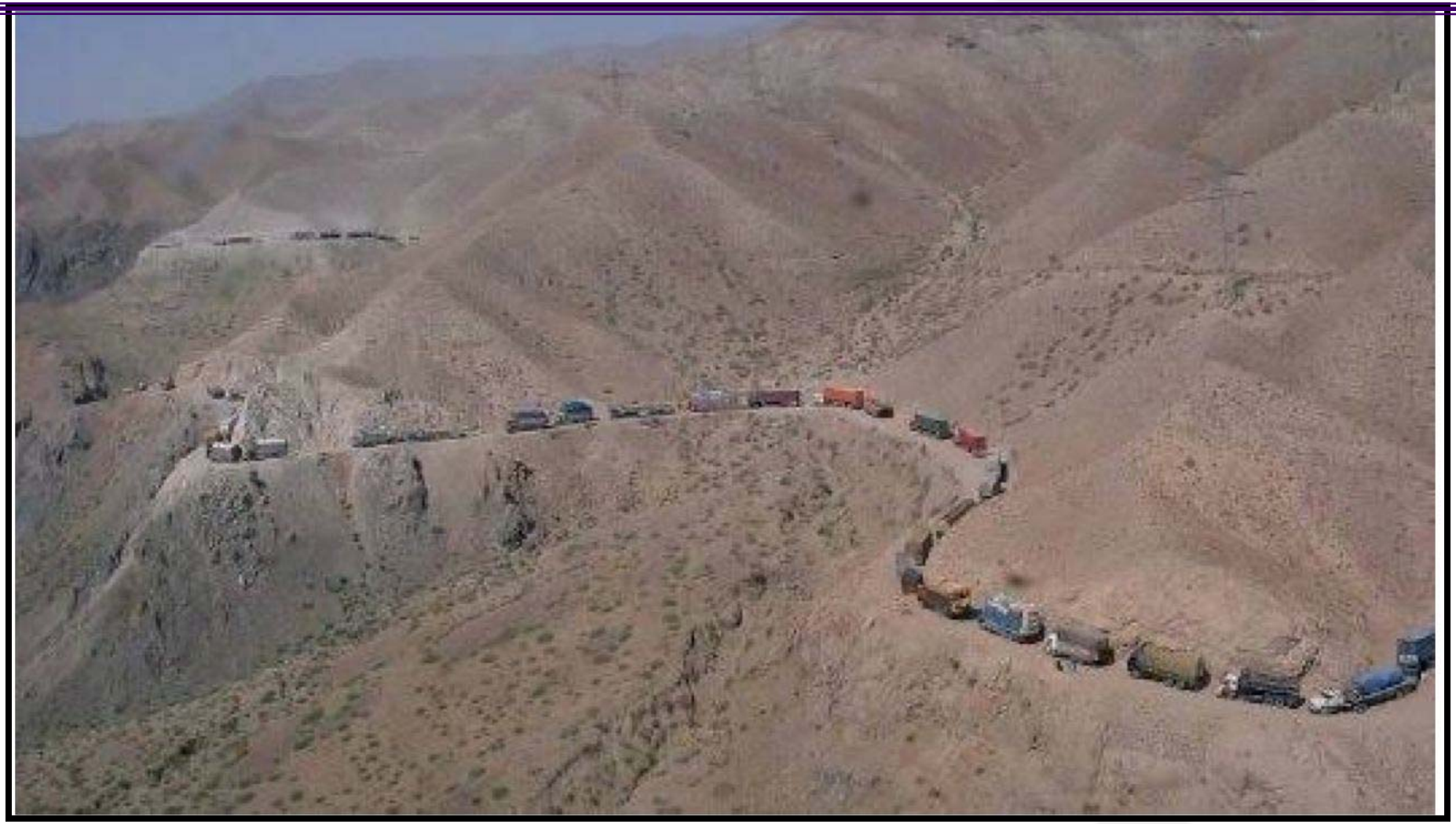
DoD Identifies Climate Change as a threat

According to the 2010 Quadrennial Defense Review,

"While climate change alone does not cause conflict, it may act as an accelerant of instability or conflict, placing a burden to respond on civilian institutions and militaries around the world." (85)



The Military's Tether of Fuel



DoD's Clean Energy Efforts

Operation Free

Taken the Message to Highest Levels


KANSAS
59
OPERATION FREE

Learn More and Get Involved

www.trumanproject.org

www.operationfree.net

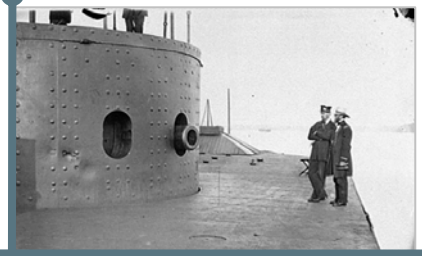
Navy Leadership in Clean Energy

Rear Admiral Philip Cullom
Director, Energy and Environmental Readiness Divison, N45

22 Sep 2010

The Navy and Energy Transformations

- The Navy has been a pioneer of energy transformations throughout its history
  - Sail to steam
  - Coal to oil
  - Oil to nuclear power
- Every transformation has provided strategic and tactical advantages despite initial skepticism
- Energy requirements have shaped the course of conflicts



Past

Present

Energy Successes

China Lake Geothermal Power Plant, 270 MW

Shipboard Incentivized Energy Conservation Program (i-ENCON)

Guantanamo Bay Wind Farm

Aviation Training Simulators

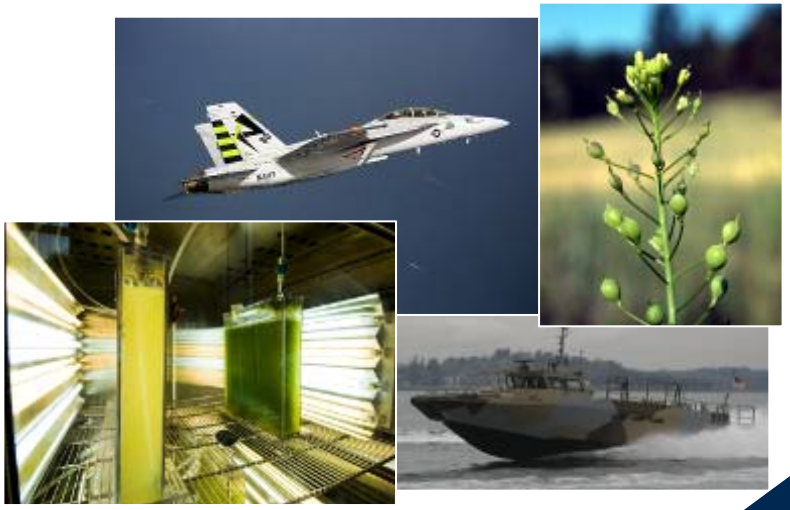
San Diego Solar PV

New Initiatives Afloat and Ashore

Alternatives

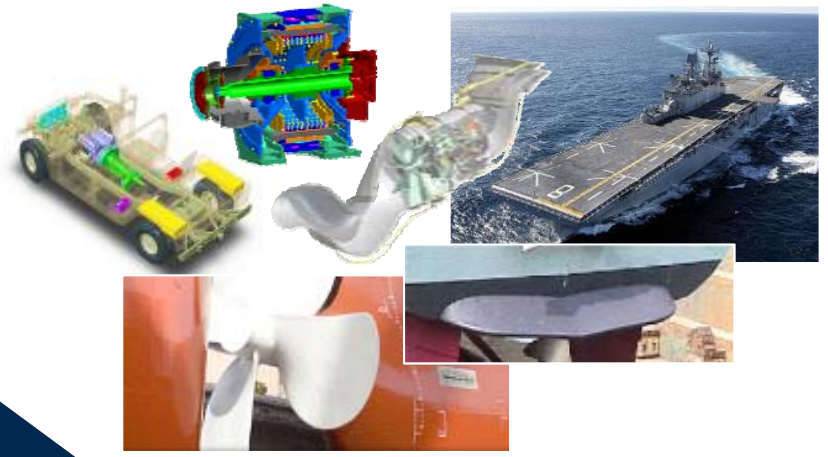
Assure Mobility & Protect Critical Infrastructure

Afloat



Efficiency

Expand Tactical Reach & Lighten the Load



Energy Security

Ashore

USS Makin Island (LHD 8)

Construction & Builders Trials
May 2003 – April 16, 2009

- General Navy initiative to reduce class Total Ownership Costs by phasing out conventional steam systems
- LHD 8 designed with gas turbine engine and electric auxiliary propulsion system (APS)

Maiden Voyage
July 10 – August 14, 2009

- Transit from Pascagoula, MS around South America to San Diego, CA
- Approximately $2 M savings over predecessor steam ships
- Cost avoidance realized over service life at this rate would be $248M

Commissioning
October 24, 2009

- Gas turbine propulsion plant meets all mission requirements
- Electric APS primarily saves fuel
  - Significant annual fuel savings and reduced maintenance costs
  - Propulsion plant redundancy
  - Flexible drive system configuration
  - Reliable source of propulsion covering >70% of operating profile
  - Supports speeds up to 12 knots

USS MAKIN ISLAND: First demonstration of hybrid electric propulsion system in amphibious assault ship to expand tactical reach and increase fuel efficiency afloat

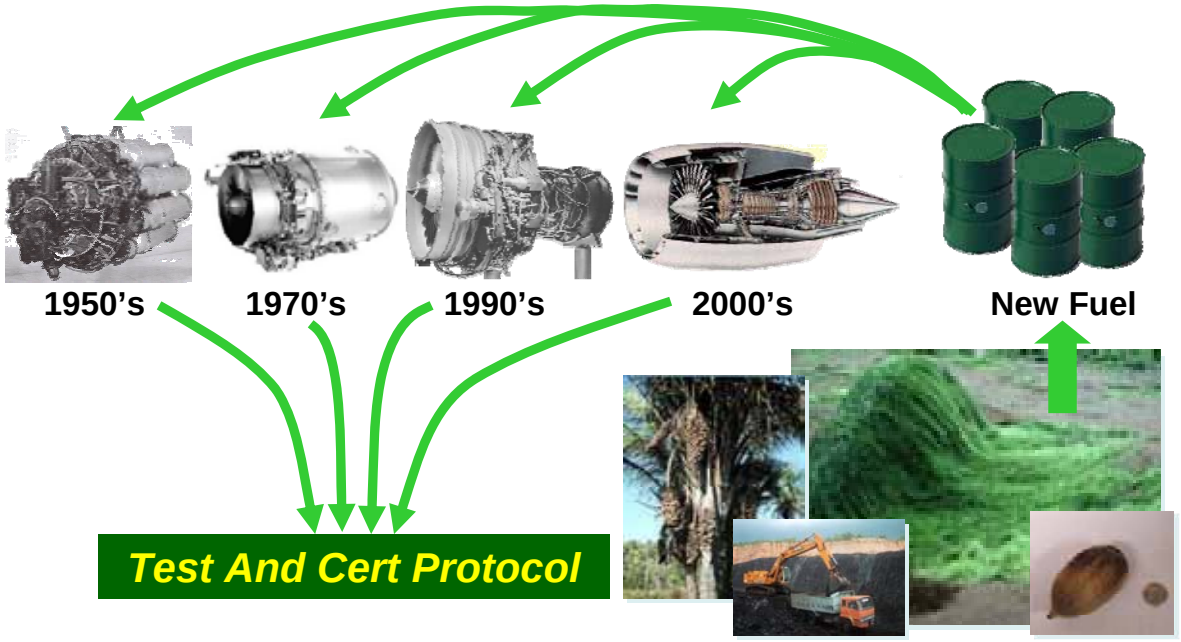
Alternative Fuels Strategy

Primary Assumption:
Alternative fuel must be a drop-in replacement, invisible to the operator

- ✓Meets fuel performance requirements
- ✓Can be mixed or alternated with petroleum fuel
- ✓Requires NO change to aircraft or ship
- ✓Requires NO change to infrastructure

Challenge:

Existing Engines



Engineer the fuel, not the platform

Why Next Generation Biofuels?

1st-Gen Biofuels:	Camelina	Algae
• Water separability • Stability issues ➢ Fuel degrades rapidly in storage, leads to filter plugging • Material compatibility, corrosion ➢ Elastomers & polymers • Lower energy density	• Grows on marginal land • Excellent rotational crop • 60-85% potential GHG emissions reduction • Grown in Montana • Produced by Sustainable Oils	• Potential yield: 6,000 gallons/acre • 60-80% potential greenhouse gas emissions reduction • Initial 20,000 gallons to be produced by Solazyme

1st-Gen biofuels unacceptable for tactical systems

Green Strike Group

Navy Task Force Energy has worked with DASN(Energy)* to further define requirements for the 2012 and 2016 demonstrations

Fleet Composition






2012 Green Strike Group

- All ships and aircraft in demo group certified to run on 50/50 biofuel blend
- One destroyer will contain full load out of biofuel or fuel will be split among CG/DDG
- Carrier will contain one tank of aircraft biofuel
- CSG will feature fuel saving technologies, e.g. GT improvements, solid state lighting
- CSG will conduct exercise in local operations

2016 Great Green Fleet

- Each ship will contain full load out of biofuel
- Carrier will contain full load out of aircraft biofuel
- GGF will include at least one Destroyer featuring Hybrid Electric Drive
- CSG will feature additional fuel saving technologies
- CSG will go on deployment

* Office of the Deputy Assistant Secretary of the Navy for Energy, established by SECNAV in spring 2010

Energy Innovation

USS Constitution, 1797

Then

Green Hornet, 2010

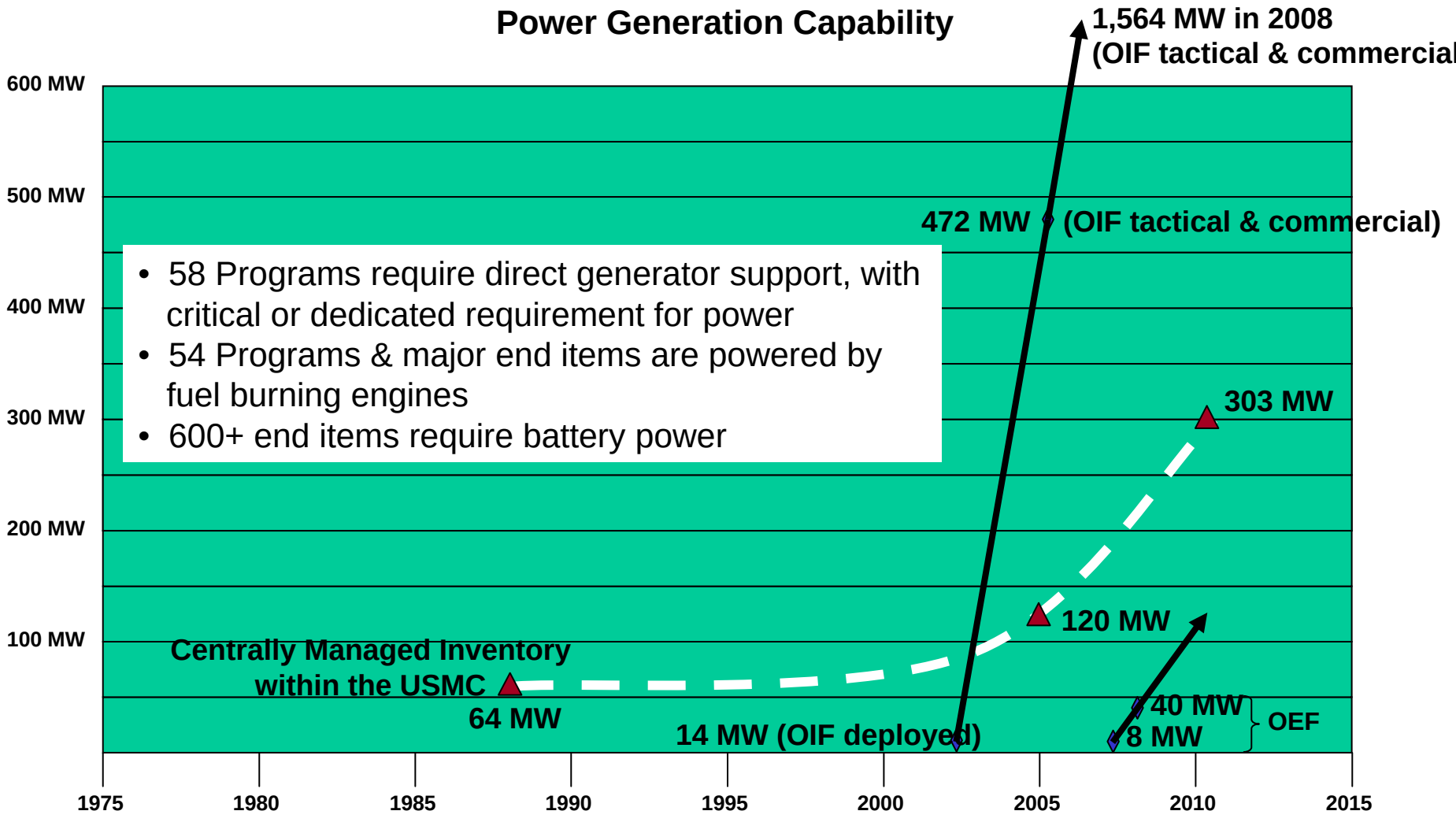
Now

Next Opportunity - Navy Energy Forum, Ronald Reagan Center, 12-13 October

USMC Expeditionary Energy

Col Bob "Brutus" Charette, USMC
Director, Expeditionary Energy Office (E²O)

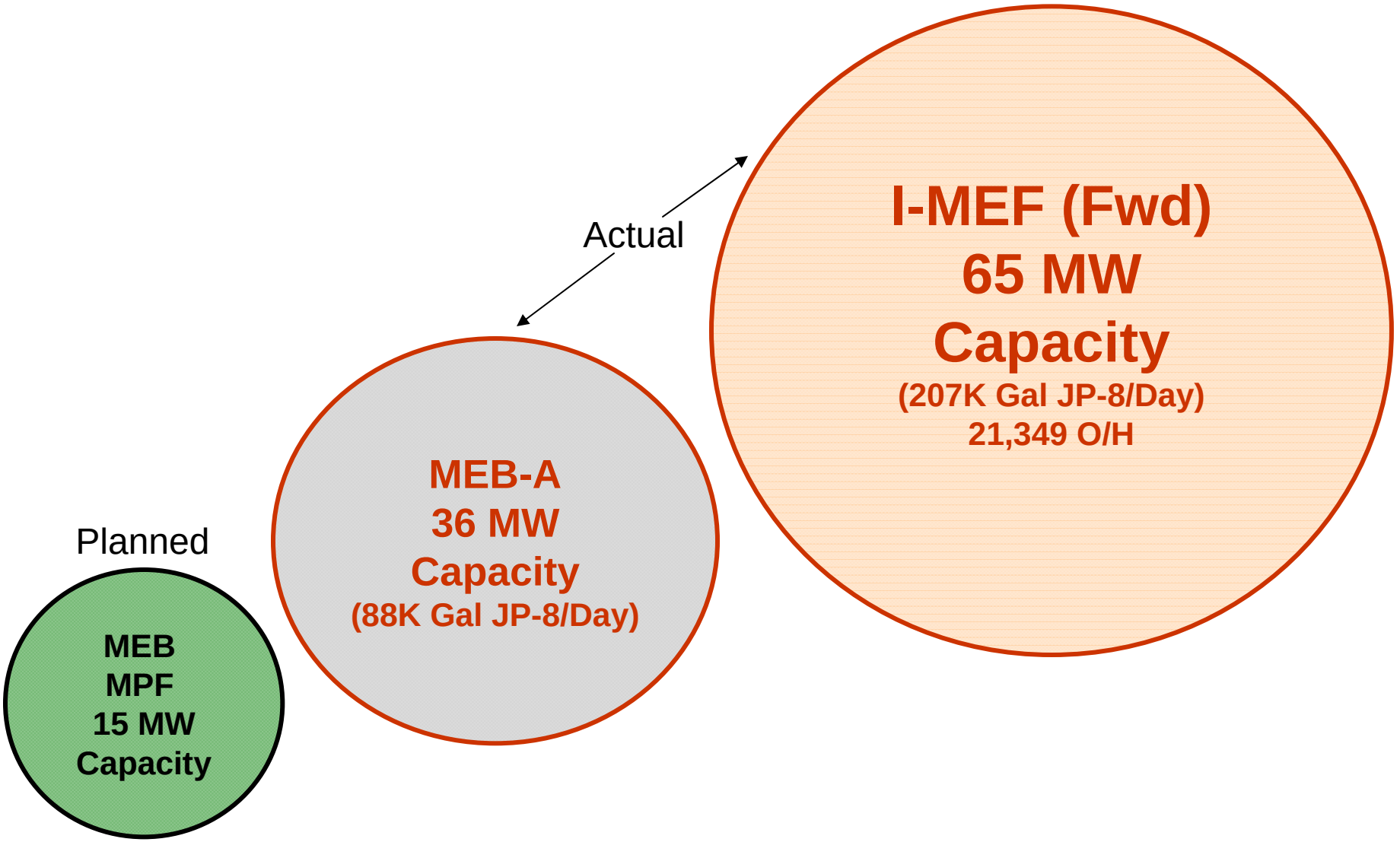
MAGTF Energy Demand Rising



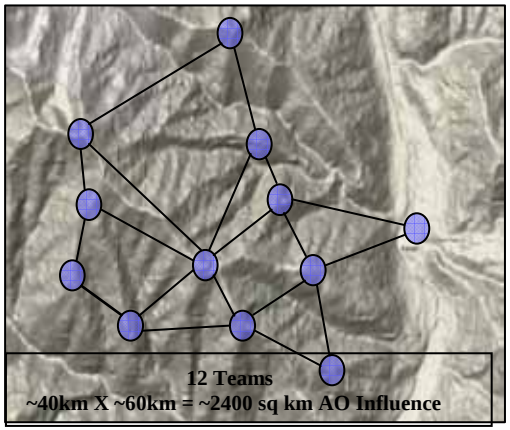
- 58 Programs require direct generator support, with critical or dedicated requirement for power
- 54 Programs & major end items are powered by fuel burning engines
- 600+ end items require battery power

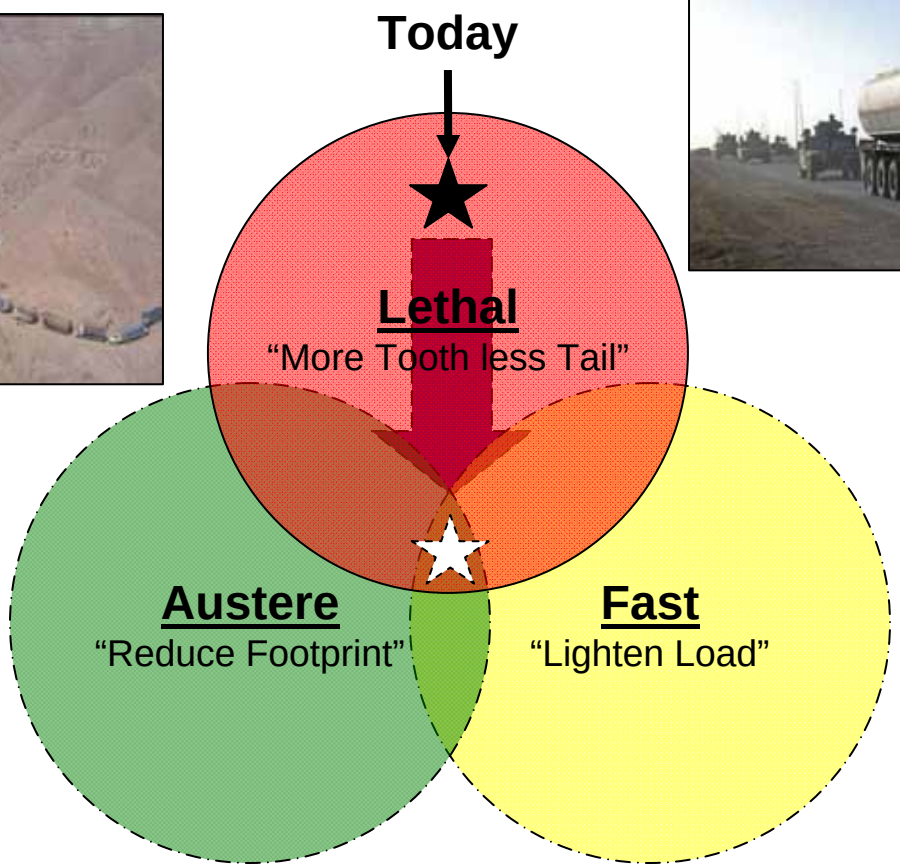
Must reduce demand, employ alternatives to fossil fuels, and improve efficiencies.

Demand For Fuel Rising
Due to Rising Demand for Watts



Energy is Combat Effectiveness





Human Cost

Afghanistan

2003 - 2007

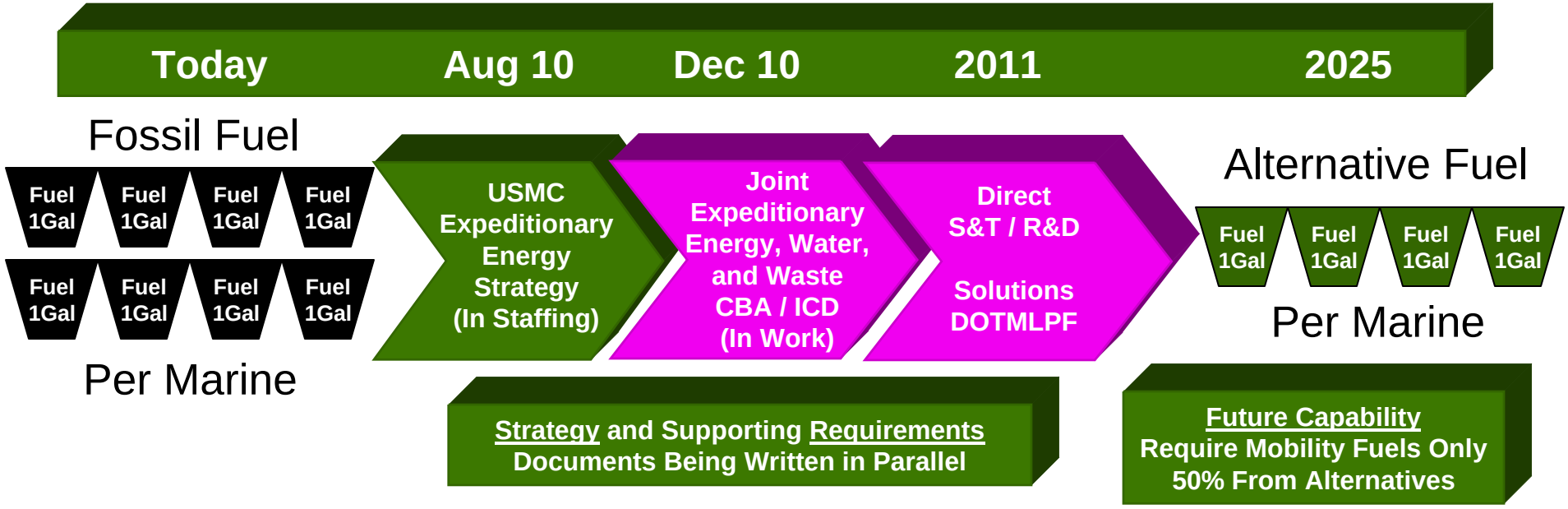
- 1 Killed or Wounded for every 24 Fuel Convoys*
- 1 Killed or Wounded for every 29 Water Convoys*

***Source: Sustain the Mission Project, Final Report dtd Sep 2009**

Energy Strategy POA&M

"Bases-to-Battlefield"

Reduce Demand + Increase Efficiency + New Alternative Technologies = (Non-Material Solutions + New Material Solutions)
<u>Increase Combat Effectiveness</u>

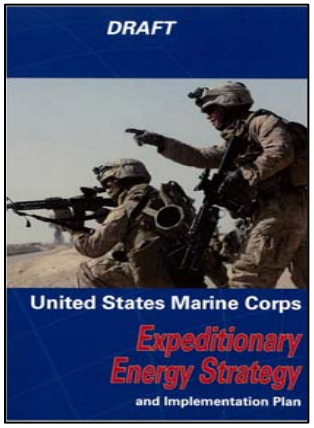


Roadmap To Success

"Why"

- **Achieve resource self-sufficiency in expeditionary environments**
- **Lessen energy consumption and dependence on fossil fuels**
- **Reduce our overall footprint in current and future expeditionary operations.**
- **Lighten the combat load**

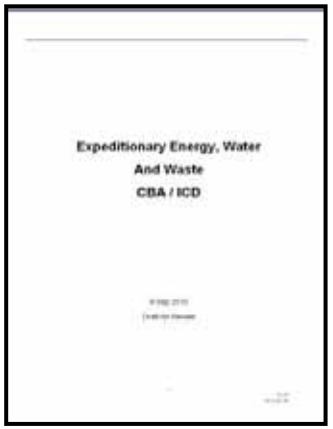
"Who, What, Where, When"



- **Embed Expeditionary Energy Ethos in USMC Culture**
- **Lead and Manage Expeditionary Energy Performance**
- **Increase Energy Efficiency of Systems and Platforms**
- **Increase Aviation Efficiency**
- **Meet Operational Demand with Renewable Energy**

(Does not include Bases and Stations Goals)

The Beginning of the "How"



- **Currently, 29 Capability Gaps Indentified**
- **Planning = 8 gaps**
- **Production = 6 gaps**
- **Distribution = 3 gaps**
- **Storage = 6 gaps**
- **Disposal = 2 gaps**
- **Management = 4 gaps**
- **Intend to fund CDD/CPD/DCR in order of GAP significance**

Experimental Forward Operating Base (ExFOB)






Objectives:

- Phase I/II - Evaluate COT technologies for training and deployment to OEF
- Phase III – Extended User Evaluations
- Phase IV – Demonstrate Less Mature Solutions
- Next Phases - TBD

Approach:

- Joint Approach
- Contracting, Legal, and Fiscal
- Rapid Evaluation of Technology
- Training and Deployment Most Promising Technology
- Evaluation and Feedback
- Expedite Programs of Record

Implementation Schedule:

- African Lion – 10 May – 17 May
- Enhanced Mojave Viper – July 10
- 3/5 Deployment

Cost:

- Phase I/II - $2.5M (Purchase of Gear Included)
- Phase III - $500K (Training Costs)
- Phase IV - $500K (No Purchase of Gear)
- Total Cost to Date - $3.5 M

ExFOB Phase 3

- India Company 3/5 (150 Marines)
  - Trained and Operated 200+ hrs. on renewable energy (29 Palms)
  - Deploy to Afghanistan this Fall with renewable energy

No fossil fuel used for command, control, and life support

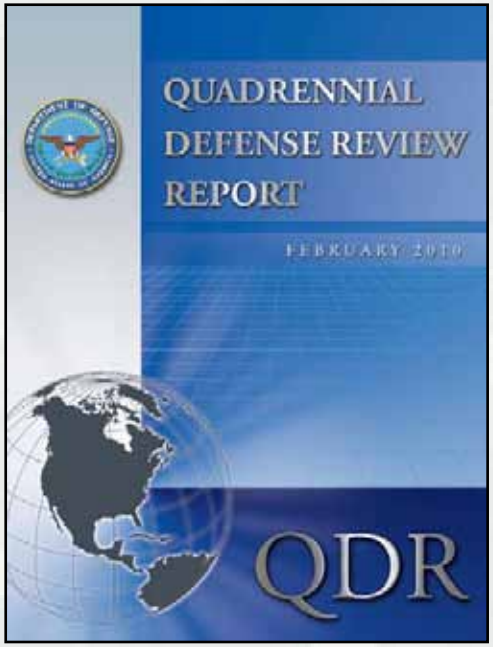
Carnegie Council of Ethics in International Affairs – Leading by Example

Presenter: GEN Deluca

U.S. Army Corps of Engineers

22 September 2010

Quadrennial Defense Review
FEB 2010



Energy Security – "*assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs" – pg 87*

- DoD will
  - promote investments in energy efficiency
  - ensure that critical installations are adequately prepared for prolonged outages caused by natural disasters, accidents, or attacks
- Balance energy production and transmission to preserve test and training ranges and operating areas needed to maintain readiness

Focused on four specific issues where reform is imperative:

- security assistance
- defense acquisition
- defense industrial base
- **energy security**

and climate change

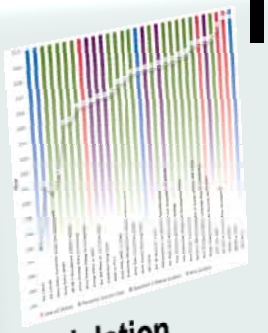
" **Energy efficiency** *can serve as a force multiplier, because it increases the range and endurance of forces in the field and can reduce the number of combat forces diverted to protect energy supply lines…" – pg 87*

- DoD will fully implement the energy efficiency KPP and fully burdened cost of fuel

QDR energy security discussion is consistent with Army approach and priorities

Army Energy Security Implementation Strategy

- 13 JAN 2009 -

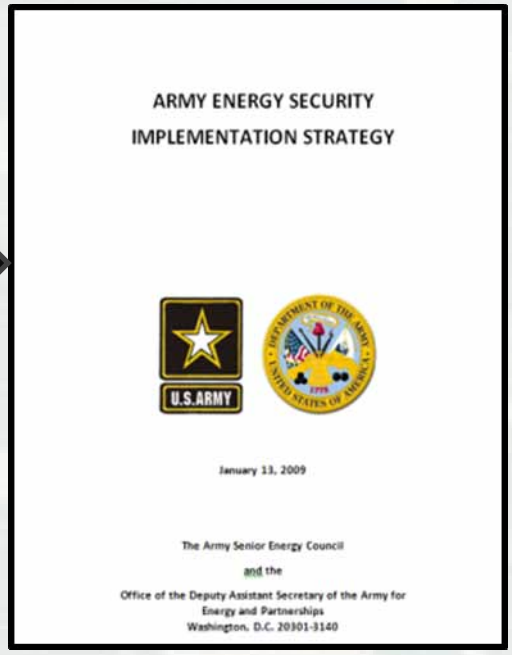


Legislation
- EPAct 2005
- EISA 2007
- NDAA

Executive Order
- EO 13423

OSD Policy
- DODI 4170.11, DOD Managers Handbook

Army Policy
- AR 420-1
- Army Energy & Water Campaign Plan



ARMY ENERGY SECURITY
IMPLEMENTATION STRATEGY

January 13, 2009

The Army Senior Energy Council
and the
Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships
Washington, D.C. 20301-3140

Currently 57 Metrics

Energy Security Goals (ESGs)

1. Reduce Energy Consumption
2. Increase Energy Efficiency Across Platforms and Facilities
3. Increase Use of Renewable/ Alternative Energy
4. Assure Access to Sufficient Energy Supplies
5. Reduce Adverse Impacts on the Environment

http://www.asaie.army.mil/Public/Partnerships/doc/AESIS_13JAN09_Approved%204-03-09.pdf

Example Energy Security Projects

- BLACK: Existing System
- BLUE: Planned Project
- RED: Development or Testing Project

Renewable Energy Summary

TOTAL PROJECTS – 66 +

363 Million Btu = Renewable Energy Generation
(23.8 GWH = Renewable Electricity)

Hawthorne Army Depot, NV
(Geothermal Power, ECIP)

Camp Williams, UT
(Wind Power, ECIP)

Fort Carson, CO *(Solar PV Array, PPA)*

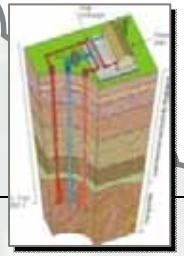
Fort Drum, NY
(Solar Wall, ECIP)

Fort Knox, KY
(Ground Source Heat Pumps, UESC / ECIP)

Fort Irwin, CA
(Solar power, EUL)

Fort Sill, OK
(Micro-grid Field Demonstration, ARRA)

Fort Bliss, TX
(Geothermal Well Tests, ARRA)



Fort Huachuca, AZ
(Rooftop PV, ITTP)

Fort Jackson, SC
(Fuel Cells, RDT&E)

Fort Bragg, NC
(LEED Platinum Bldg ESTCP/ITTP)0

FUNDING SOURCES:

- **EUL:** Enhanced Use Lease
- **ITTP:** Installation Technology Transition Program
- **ECIP:** Energy Conservation Investment Program
- **UESC:** Utility Energy Service Contract
- **ARRA:** American Recovery and Reinvestment Act of 2009
- **PPA:** Power Purchase Agreement

BUILDING STRONG®

Examples of Major Army Energy Initiatives with Potential for Partnering

- **"Net Zero Energy"** through implementation of on-site renewable energy generation, reduced energy consumption and improved energy efficiency.
  - **By end of FY12, five installations designated to become "Net Zero Energy" by FY21**.
  - **Twenty-five installations designated by end of FY14 to become "Net Zero Energy" by FY31.**

- **Hawthorne Army Depot, NV will be energy secure,** capable to operate off the commercial power grid, with base-load energy produced from geothermal sources 24/7.

- **Field "smart grid" technologies for non-traditional installations (forward operating base camps).** *Smart-grid capabilities* will increase the energy security of operational forces with more efficient use of traditional power Generators and the capability to capture and distribute energy from the sun and wind.

U.S. Army Corps of Engineers Strategic Sustainability Performance Plan (SSPP)

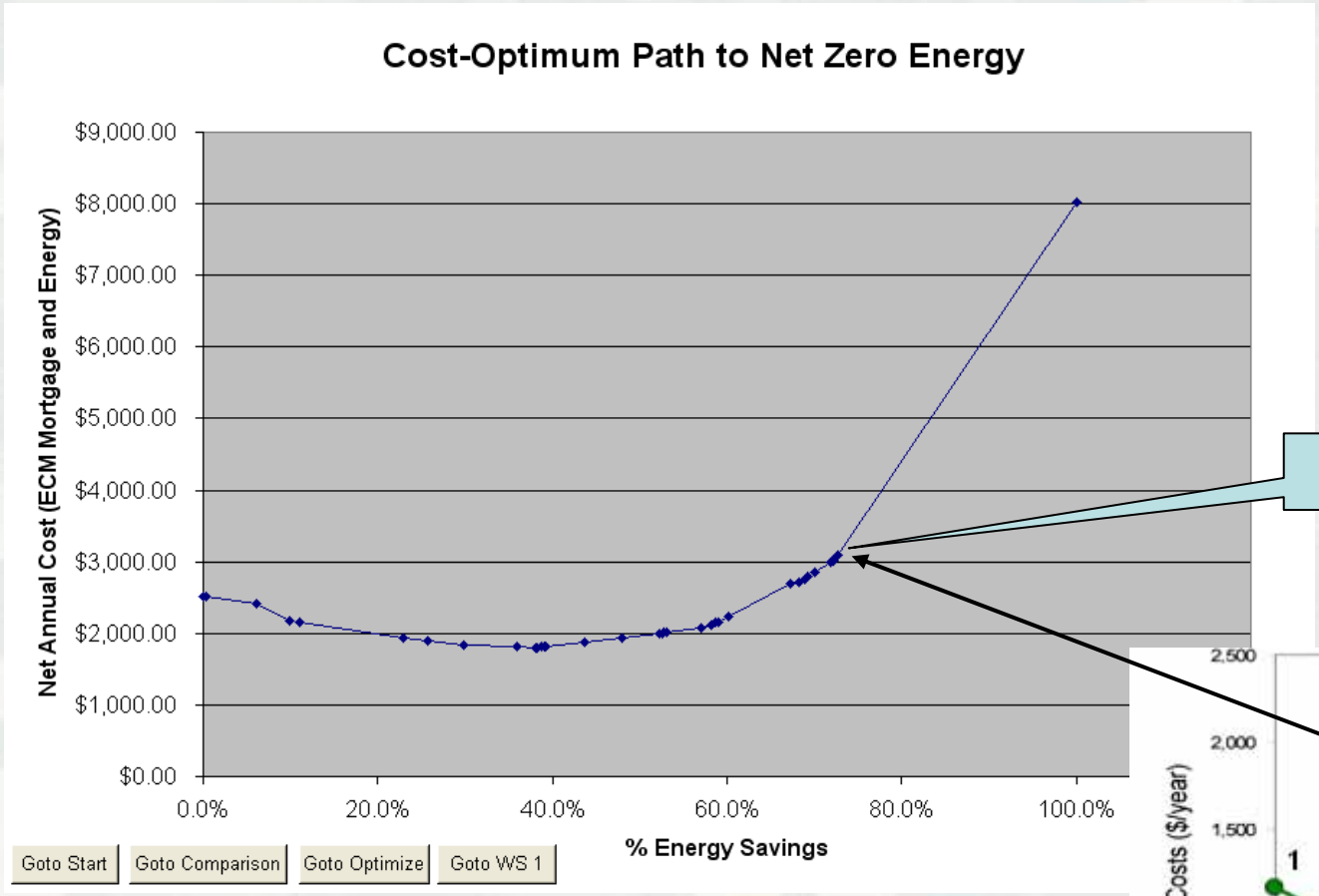
(Executive Order 13514-*Federal Leadership in Environmental, Energy, and Economic Performance*)

Ten Goals

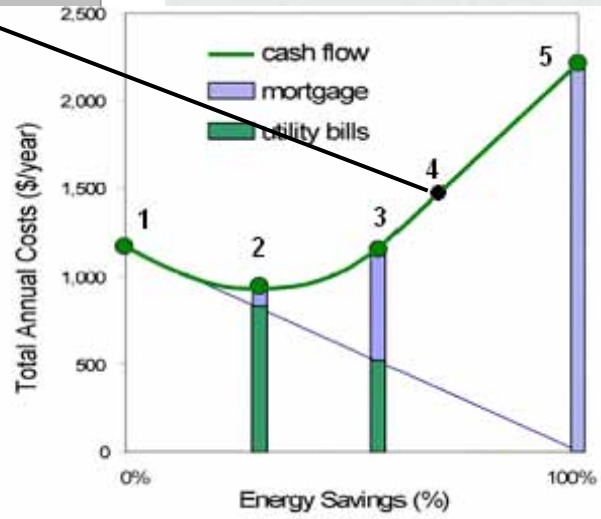
1. 23 percent reduction target for greenhouse gas Scopes 1 and 2 emissions by 2020
2. 5 percent greenhouse gas reduction target for Scope 3 emissions by 2020
3. Develop and maintain a comprehensive greenhouse gas inventory
4. Implement “Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings”
5. Engage in regional and local sustainable planning efforts
6. Improve water use efficiency and management
7. Prevent pollution and waste
8. Improve sustainable acquisition practices
9. Improve electronic stewardship practices (energy efficient data centers)
10. Implement innovative sustainable practices relate to core mission areas

Improving Building Performance

Building Simulation – CERL model



NZE Ready Point



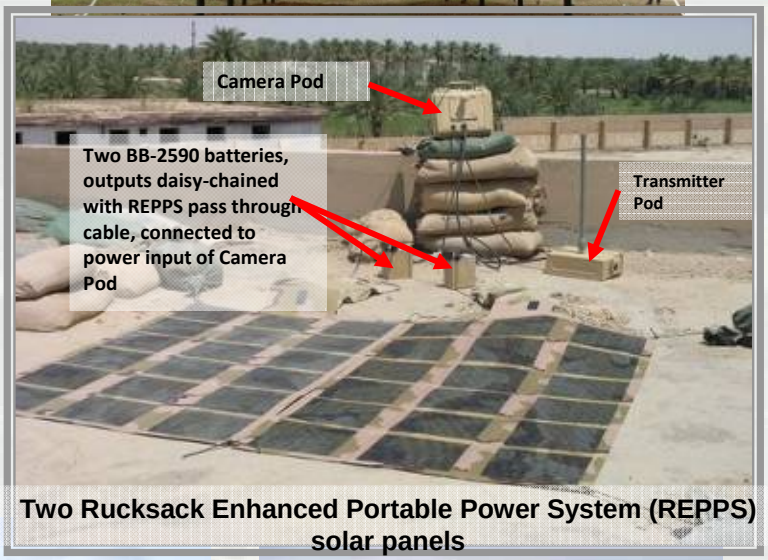
Improving Building Performance

- Energy Targets for Different Building Types
- Recommendations:
  - Adjust project scope to include enhanced energy performance and select LEED credits
    - Raise energy reduction baseline to 40 percent (baseline ASHRAE 90.1 - 2007)
    - Project scope to include select LEED credits
    - Require LEED certification at level Silver
- Path to compliance – new construction
  - USACE HDQTRS, COS, ERDC and CERL joined to perform life cycle cost on known technologies - complete by 30 sep 2010
  - Starting with the FY13 program - creating an “energy enhanced 1391 for HDQTRS Bldgs, COF’s, TEMF’s, Barracks and Dining facilities
  - Initial goals target a nominal increase of 10 percent cost to achieve:
    - 65 percent energy saving over ASHRE 2010
    - 30 percent water reduction
    - 50 percent wastewater reduction
    - 25 percent reduction in operating cost
    - Net Zero ready
    - Comply with executive orders and laws

Operational Energy Possibilities Enhance Operational Success

The Challenge:

- **Fuel logistics, management and protection are key for contingency operations success**



Two Rucksack Enhanced Portable Power System (REPPS) solar panels

Key Energy Opportunities

- Tactical Grid Management
- Distributed Generation
- Renewable/Alternative Power
- Lightweight, Flexible, Structural,or Integrated Solar
- Alternative Fuels
- Standardized Deployable Kits
- High Efficiency Systems
- Leveraging Local Opportunities

Before

After

Sea-Level Changes

Sea Levels Online

The map above illustrates regional trends in sea level, with arrows representing the direction and magnitude of change. Click on an arrow to access additional information about that station.

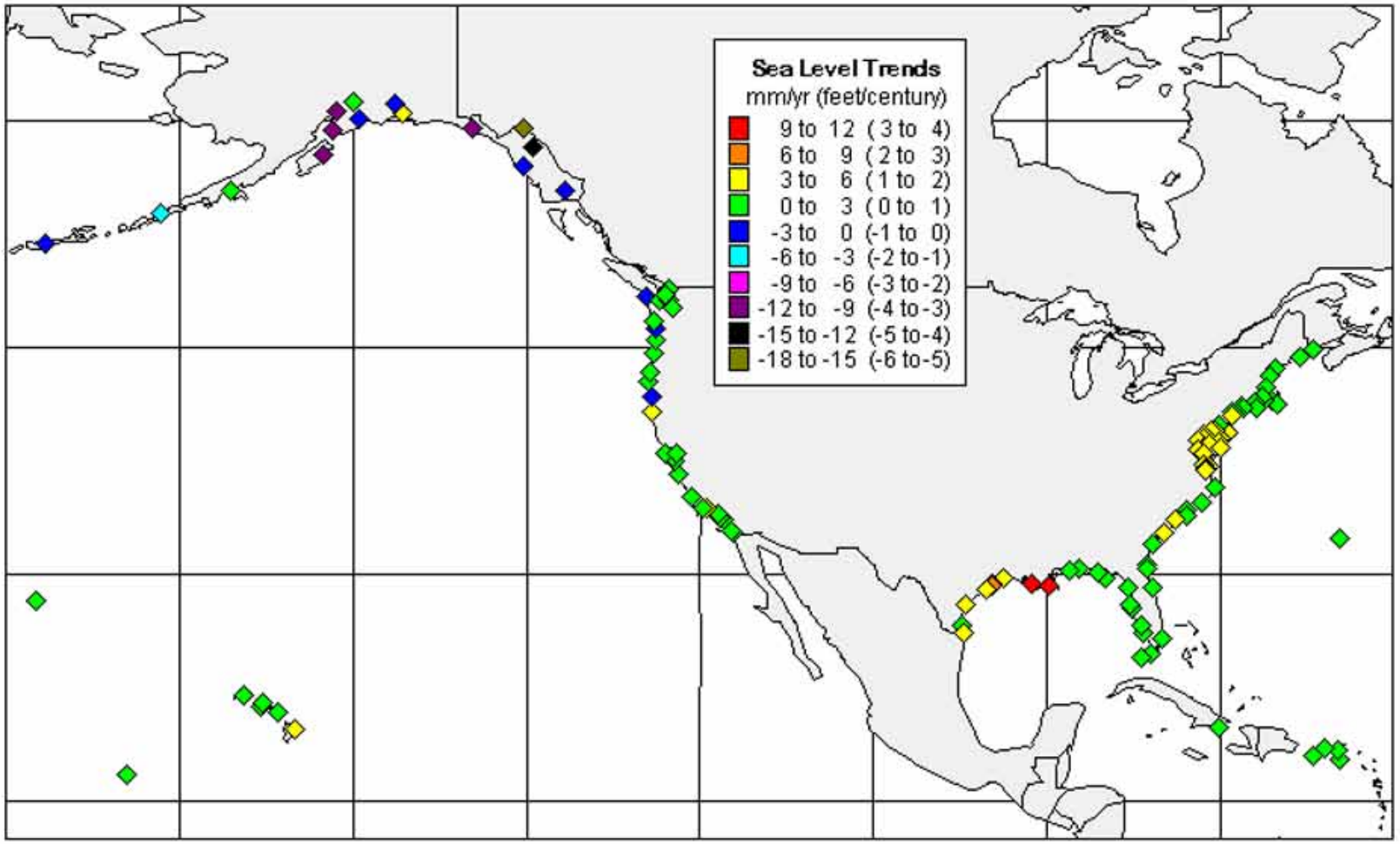
Sea Level Trends

mm/yr (feet/century)

9 to 12 (3 to 4)	3 to 6 (1 to 2)	-3 to 0 (-1 to 0)	-9 to -6 (-3 to -2)	-15 to -12 (-5 to -4)
6 to 9 (2 to 3)	0 to 3 (0 to 1)	-6 to -3 (-2 to -1)	-12 to -9 (-4 to -3)	-18 to -15 (-6 to -5)

Sea-Level Changes

Regional Mean Sea Level Trends



External Experts
USGS (Robert Thieler, Nate Plant)
NOAA (Steve Gill, Billy Sweet, Kristen Tronvig)
Bureau of Reclamation (Mike Tansey)
FEMA
Navy (Tim McHale, Shun Ling)
FHWA (Kevin Moody)
HR Wallingford, UK (Jonathan Simm)
University of Southampton, UK (Robert Nicholls)

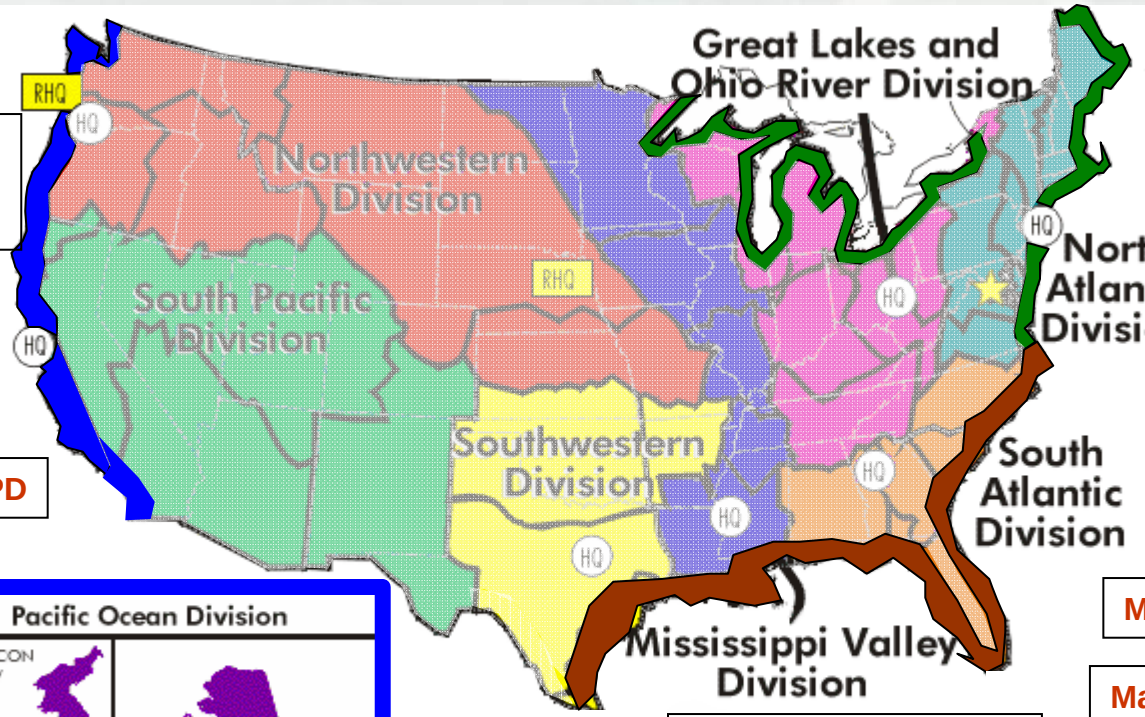
Procedures to Evaluate Sea Level Change Impacts, Responses, and Adaptation

Engineering Technical Letter Team

Mike Mohr, LRB

John Winkelman, NAE
Jeff Gebert, NAP
Larry Cocchieri, NAD and PCX

Heidi Moritz, NWP
Team Lead for Engineering



Henri Langlois, IWR
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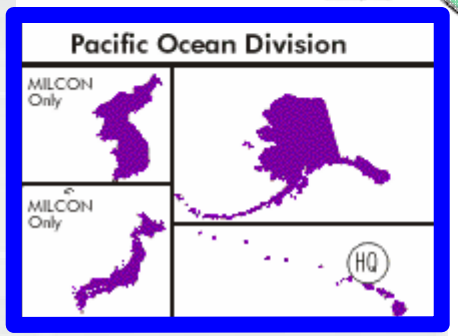
Jeff Arnold, IWR
Lauren DeFrank, IWR
Brian Harper, IWR
Rolf Olsen, IWR
Kate White, IWR

Stu Townsley, SPD



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Glenn Landers, SAJ
Mark Shafer, SAJ

Susan Rees, SAM
Dennis Mekkers, SAM
Patrick O'Brien, MVD

Justo Pena, SWG

Julie Rosati, ERDC
Andy Garcia, ERDC

Tom Smith, POH
Crane Johnson, POA

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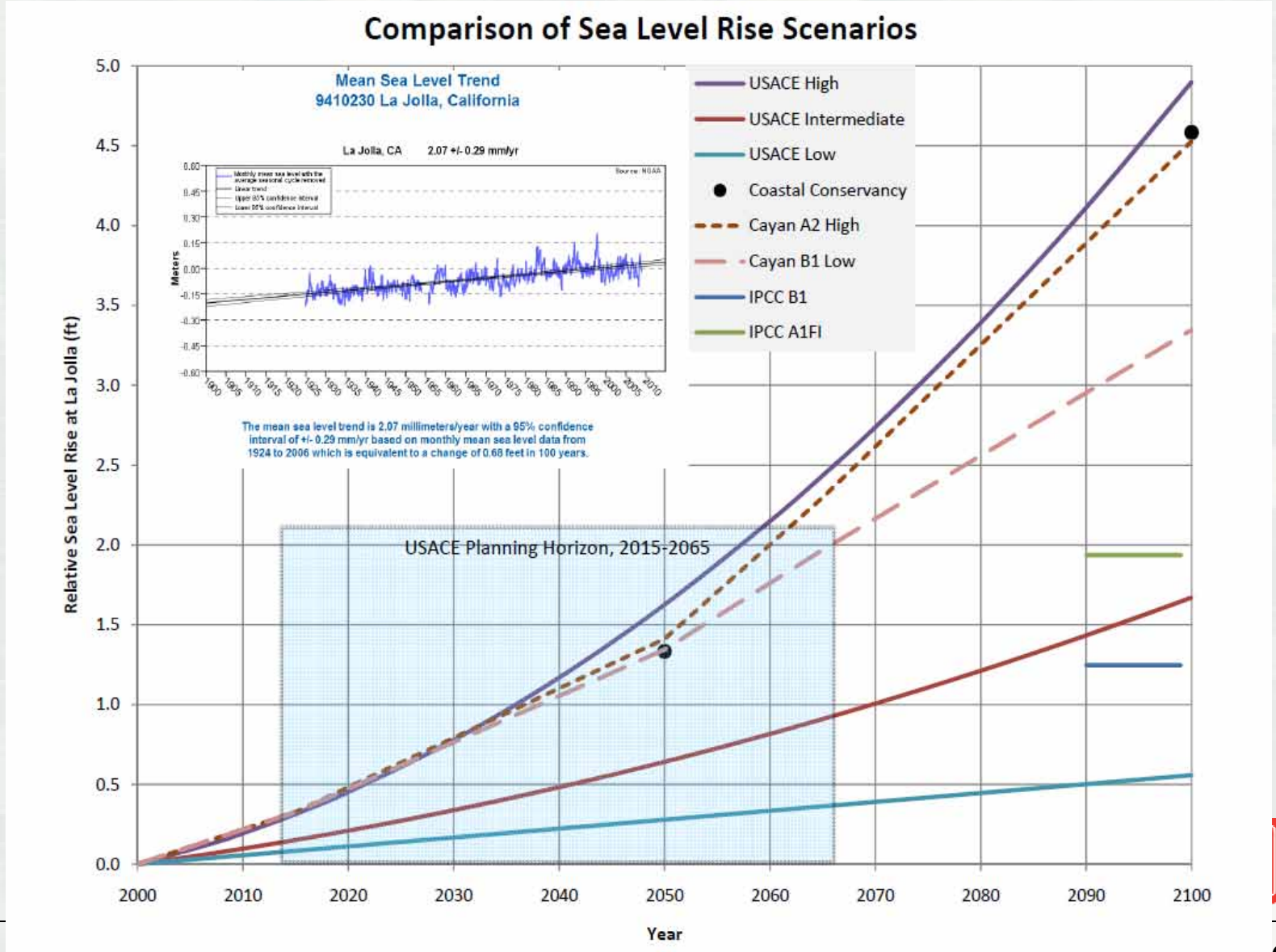
Sea-Level Changes



R&D
Innovative Energy Technologies

- Hydrogen Back-up Power Fuel Cells
- Renewable Energy