Headquarters U.S. Air Force

Integrity - Service - Excellence

Low Energy Technologies at US Air Force Sites

Year of the Air Force Family

Erica Becvar
AFCEE/TDV
13 May 2010

Overview

- AF energy focus
- AF energy drivers
- AF energy program
- AF Environmental Restoration Program
- Low energy tools
- Low energy technologies and approaches (AF and ESTCP)

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AF Energy Focus

We can't rest until we harness the renewable energy that can create millions of new jobs and new industries. …That's how we can grow our economy, enhance our security, and protect our planet at the same time.

- President Obama, 29 Apr 2009

The Air Force energy strategy furthers an energy future that is secure, efficient, and environmentally sound.

- Michael Donley, Secretary of the Air Force, Jan 2009

We must continue to identify innovative ways to conserve energy and take actions to build upon our success. Let's be passionate energy advocates, set the example, and remind those around us that our individual actions can make a significant difference in creating a more energy-efficient Air Force.

- General Norton Schwartz, USAF Chief of Staff, Jan 2009

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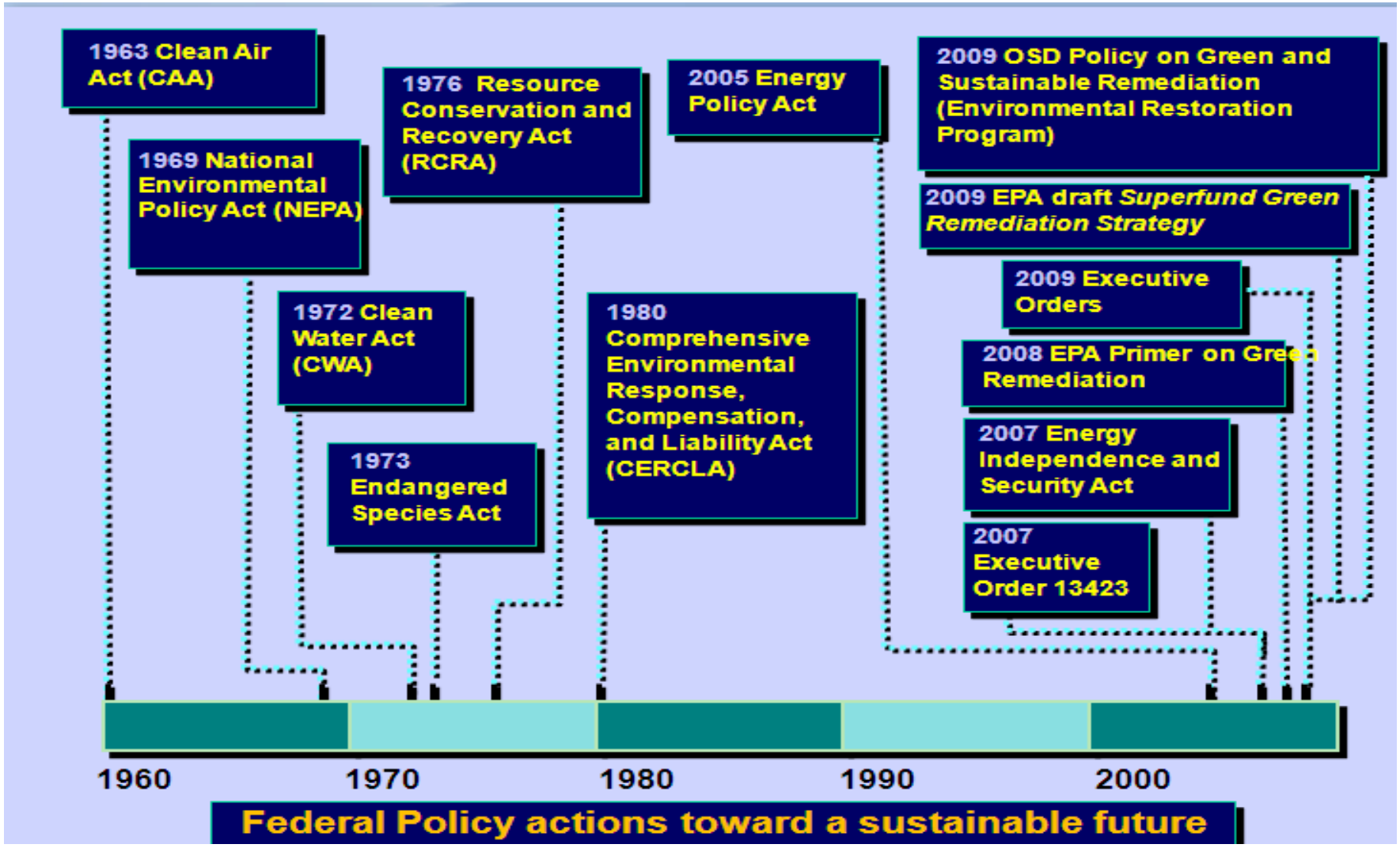
AF Energy Goals/Drivers



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AF Energy Goals/Drivers

- **Plans $2.3 B over next six years on energy and water conservation and expanded use of renewable energy projects**
- **Capital investment strategy expected by 2015 to:**
  - **Reduce energy intensity at AF facilities by 30% by 2015**
  - **Reduce potable water usage by 16%**
  - **Increase on-base renewable energy to 3% of all electricity use**
  - **Increase renewable energy to 10.5% of all electricity**

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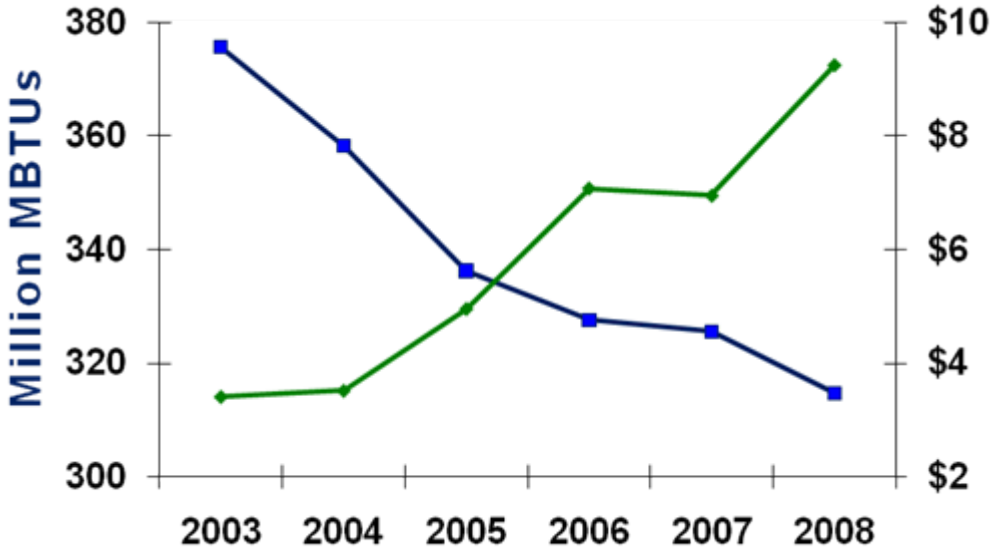
AF Environmental Program – Energy

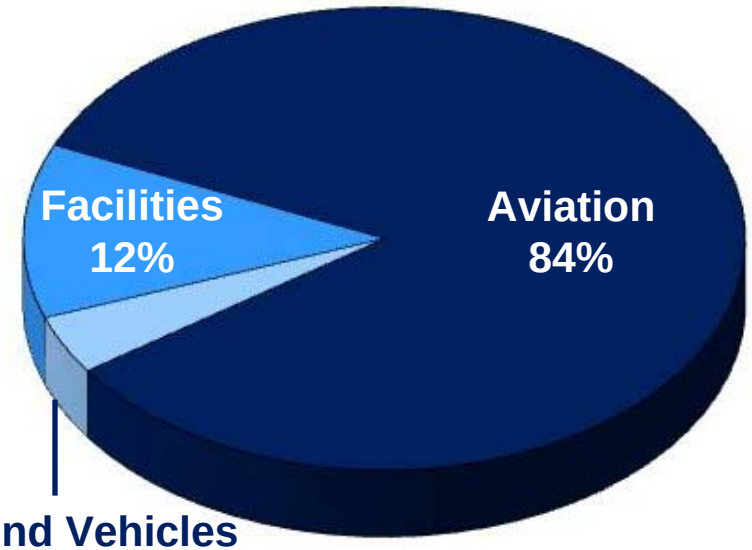
Over $9 billion spent for energy in 2008

Energy Cost and Consumption Trends



Air Force is the largest user of liquid fuels in the DoD

Energy Cost Breakdown



Energy Consumption is Decreasing While Costs are Increasing

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AF Environmental Program – Energy

- **Air Force Energy Goals:**
  - **Reduce demand**
  - **Increase supply**
  - **Culture change**

Vision
Make Energy A Consideration In All We Do

- **Invest $39.8M in FY09 via MILCON and ARRA Energy Conservation Investment Program (ECIP) projects (47% more than FY08)**
- **More than dozen ECIP projects soon break ground AF-wide; expected to save AF more than $4M/yr, conserve/produce almost 115 M BTUs, equal to powering ~ 4,000 homes**
- **Although largest consumer of energy due to fuel use, is EPA Green Power Partner –**
  - **No. 1 purchaser of green power in fed government**

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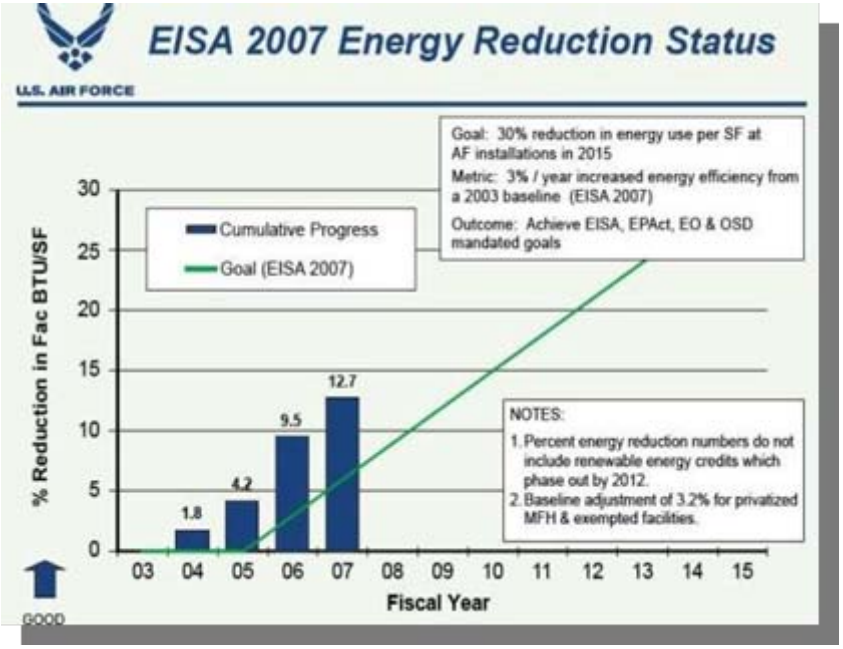
AF Environmental Program – Energy

- Met every energy conservation goal since 1975
- Reduced facility energy intensity by more than 30% 1985 – 2005
- Aggressive conservation program exists to meet EISA 2007 and EO 13423 goals; on path to meet 30% reduction by 2015



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AF Environmental Restoration Program

- Installation Restoration Program (IRP) – 572 sites in 2010
  - 6,078 sites closed, response complete, or RIP
  - Cleanup of pre-1986 contaminated sites
  - Achieve Remedy-in-Place (RIP) by 2012
- Compliance Restoration Program (CRP) – 952 sites in 2009
  - Compliance cleanup sites (post-1986 releases)
- Military Munitions Response Program (MMRP) – 455 open munitions response sites
  - Cleanup of non-operational ranges
  - Achieve RIP/Response Complete (RC) by 2020
- FY10 Budget: $414M for 648 active projects

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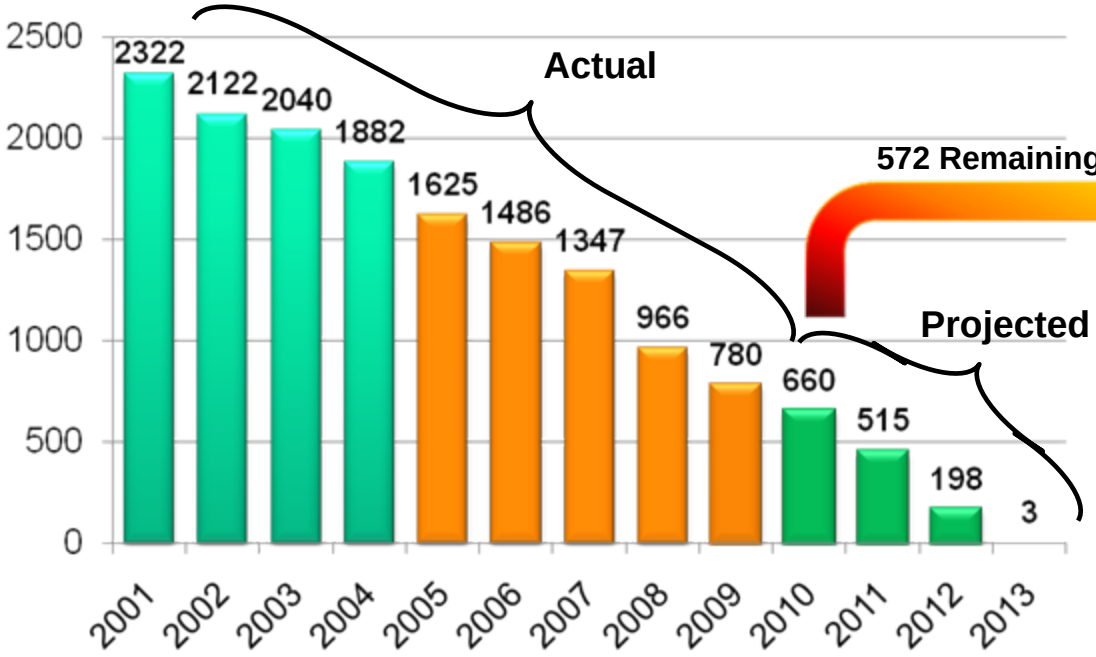
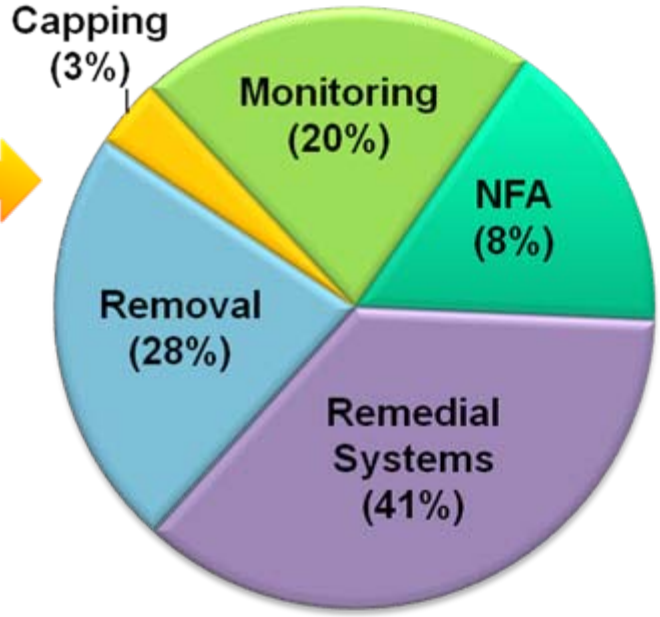
AF Environmental Restoration Program

Non RIP Sites at Start of FY



91% of sites have achieved RIP



Anticipated Remedies

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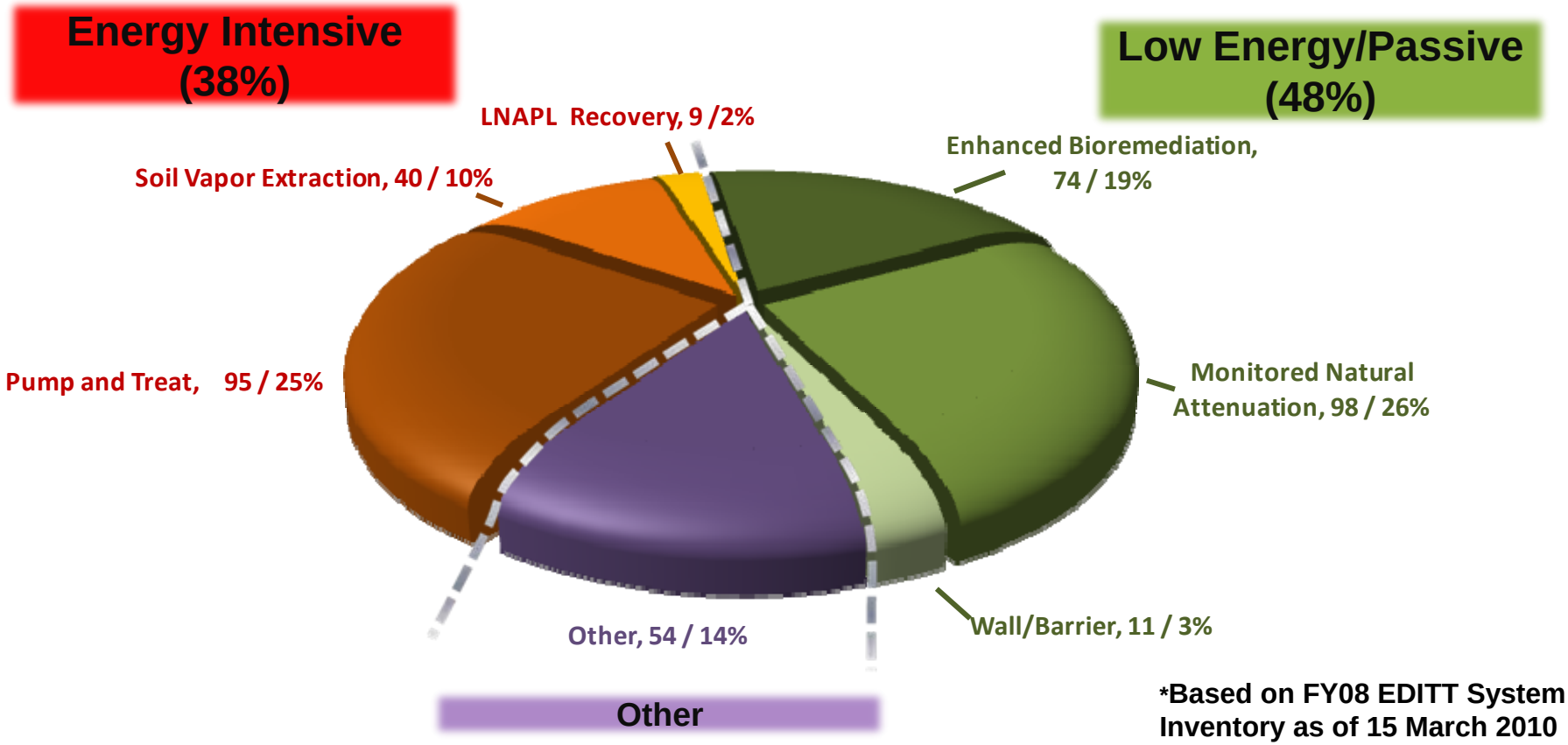
AF Environmental Restoration Program

System Inventory:
381 Remedial Systems in Operation*



*Based on FY08 EDITT System Inventory as of 15 March 2010

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AF Environmental Restoration Program

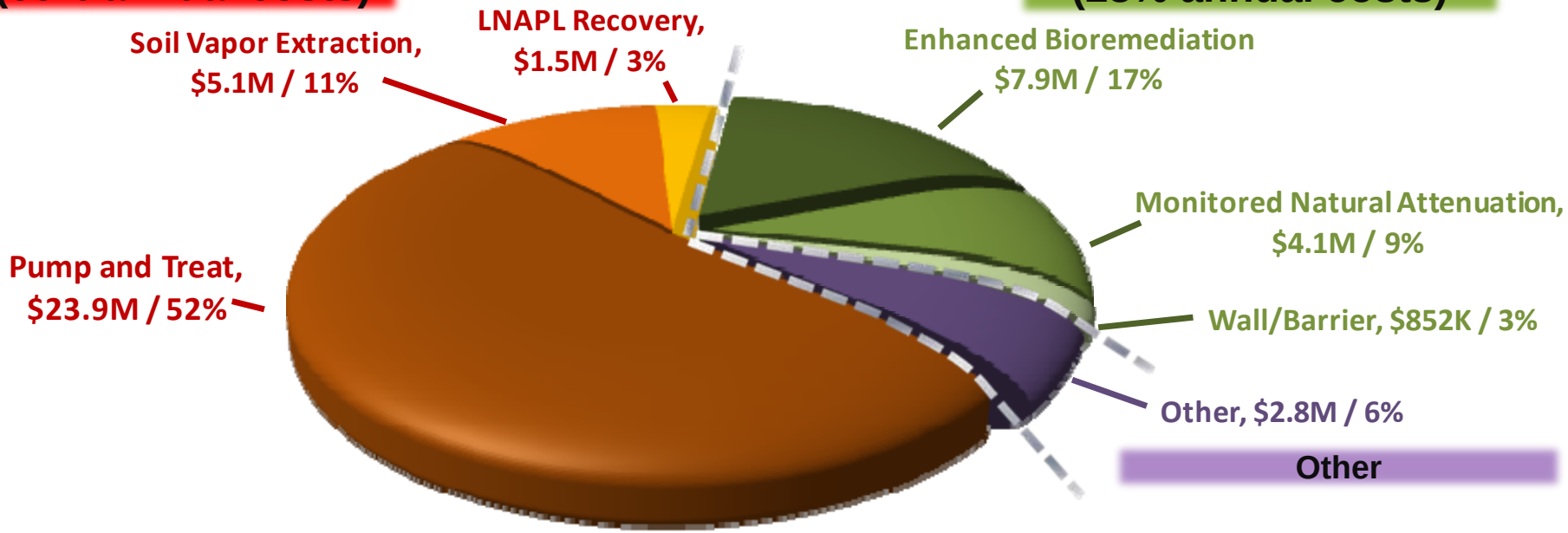
System Inventory Costs
381 Remedial Systems in Operation*

38%

48%

Energy Intensive (66% annual costs)

Low Energy / Passive (28% annual costs)



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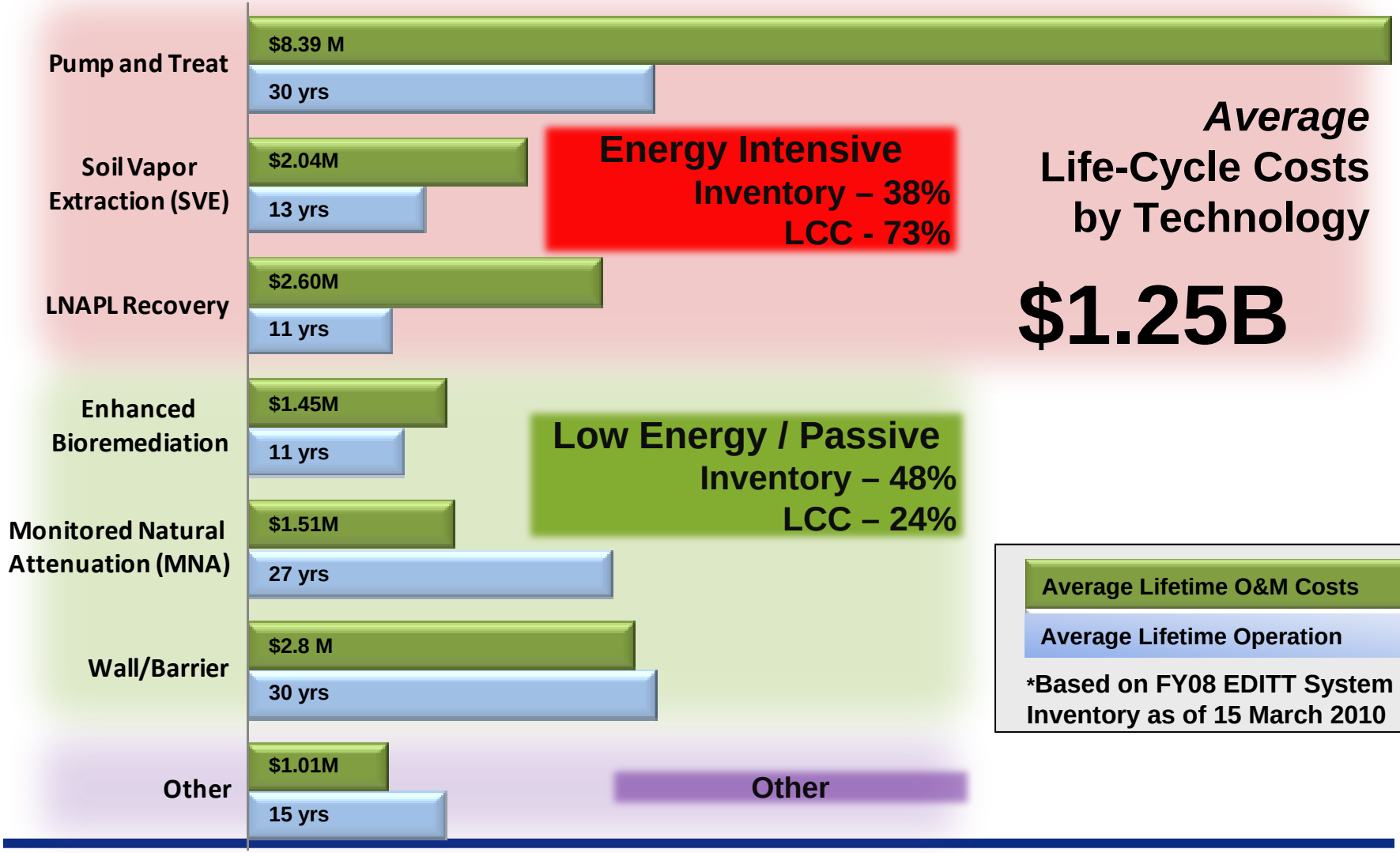
AF Environmental Restoration Program



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Energy and Sustainability in AF ERP

- Overarching goal – protect human health and environment
  - Practice of considering all environmental effects of remedy implementation and operation incorporating options to minimize the environmental footprint of a cleanup
- Key elements of the GSR initiative to <u>minimize</u>:
  - *Energy use for treatment systems*
  - *Water use/impacts on water resources*
  - *Material consumption/waste generation*
  - Impacts on *land* and *ecosystem*
  - *Air* emissions
- Objective – Incorporate GSR technologies as part of holistic approach to optimize cleanup
  - Technology-driven (green)
  - Process-centric (sustainment)

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Low Energy Tool – SRT

What the Sustainable Remediation Tool (SRT) does:

- Optimization tool … helps drive and influence GSR technology selection
- Used in future planning and optimization of existing systems
- Provides lifetime sustainability assessment
- Works in concert with Performance Tracking Tool (PTT) to evaluate performance and reduce time to site closure
- Virtual roundtable for all-party consensus
- Estimates sustainability metrics for 8 specific technologies
- Sustainability metrics estimated:
- Carbon dioxide emissions to atmosphere
- Total energy consumed
- Change in resource service
- Safety / Accident risk
- Technology cost
- NOx
- SOx
- PM10
- 15 sustainability assessments over past 8 months
- 2010 release – Interface with RACER and additional features, metrics, and technology modules

SRT

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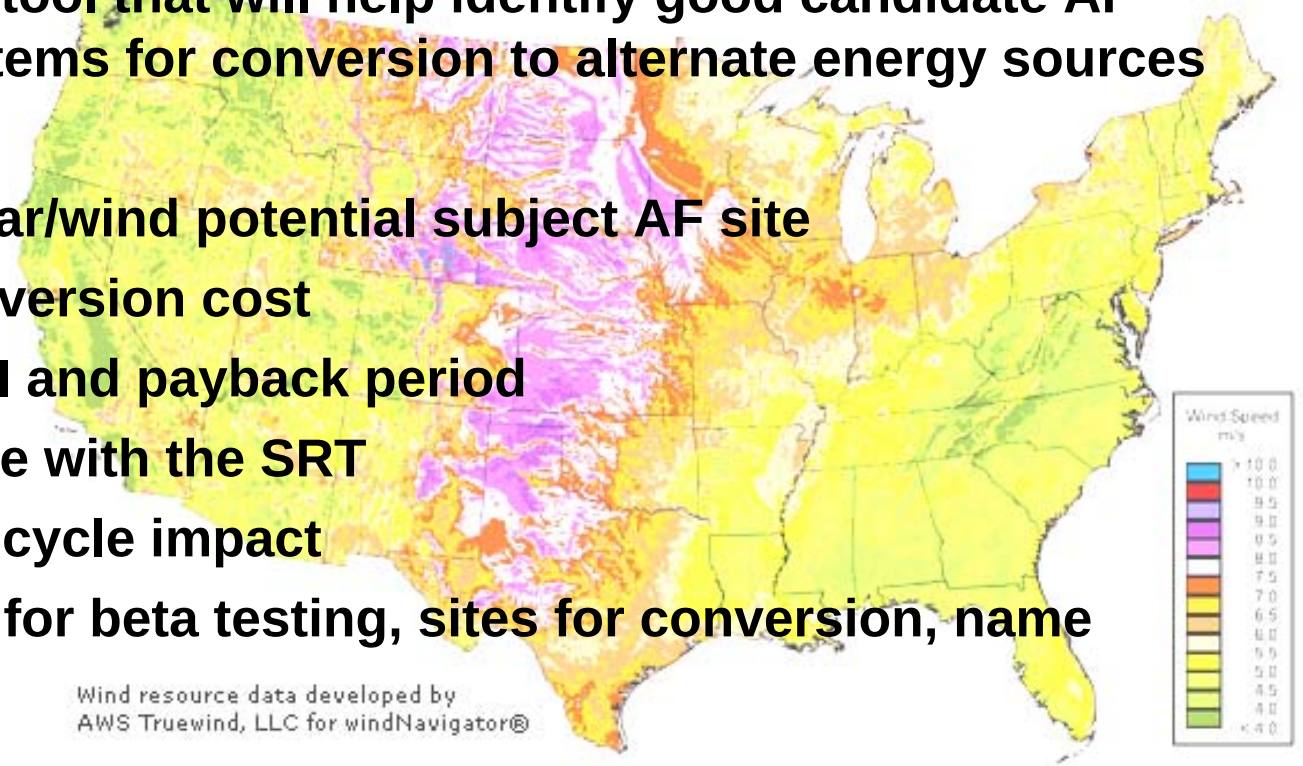
Low Energy Tool – Alternative Energy Tool

AF Renewable Energy Tool

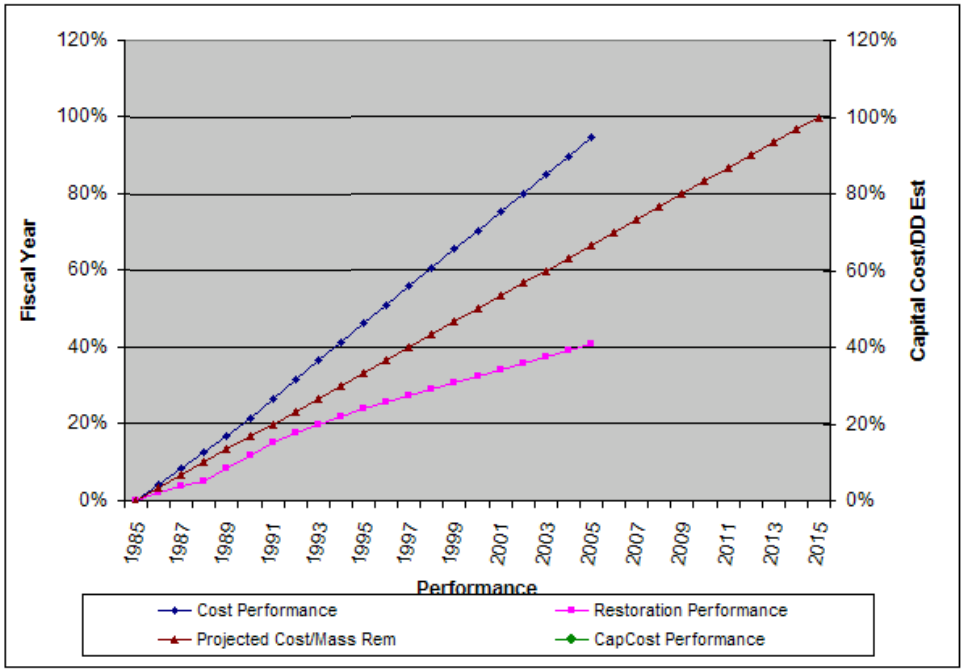
- Decision and design tool with AF and industry
- Conceived as part of AFCEE BAA process
- MS Excel-based tool that will help identify good candidate AF remediation systems for conversion to alternate energy sources
- Tool will:
  - Calculate solar/wind potential subject AF site
  - Estimate conversion cost
  - Calculate ROI and payback period
  - Be compatible with the SRT
  - Consider life cycle impact
- Need help: sites for beta testing, sites for conversion, name



Low Energy Tool – Performance Tracking Tool

Performance Tracking Tool (PTT)

- Analyzes performance sustainability of existing remediation systems
- Track remedy's performance and cost
- Normalized output for easy comparisons
- Example Technologies
  - Bioslurping
  - Monitored Natural Attenuation (MNA)
  - Pump & Treat (P&T)
  - Surfactant Extraction
  - Soil Vapor Extraction (SVE)
  - Dual Phase – SVE & P&T



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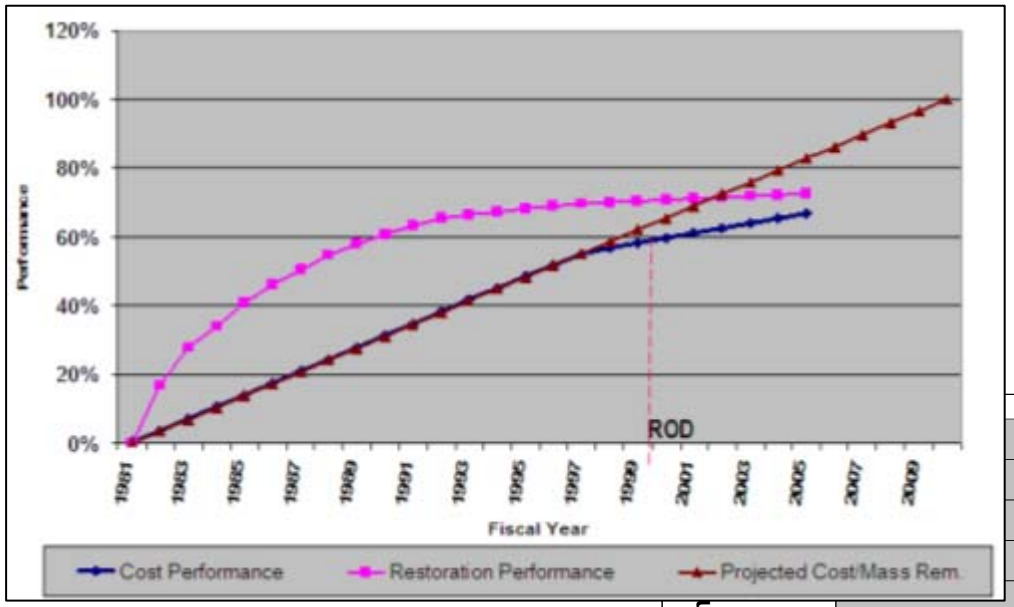
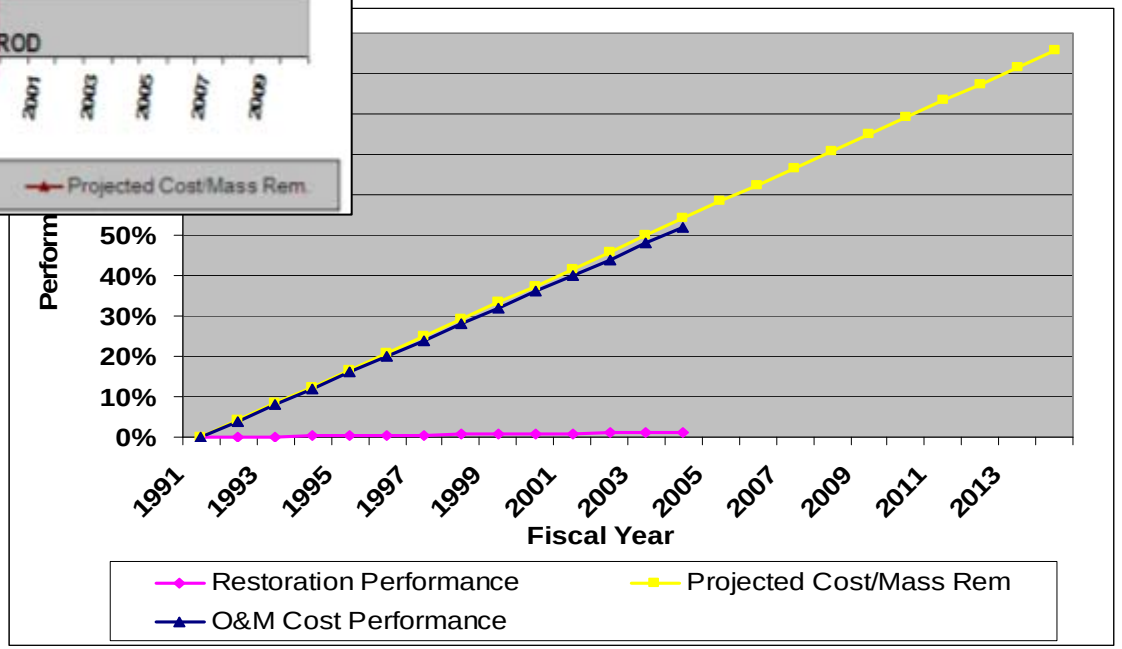
Low Energy Tool – PTT





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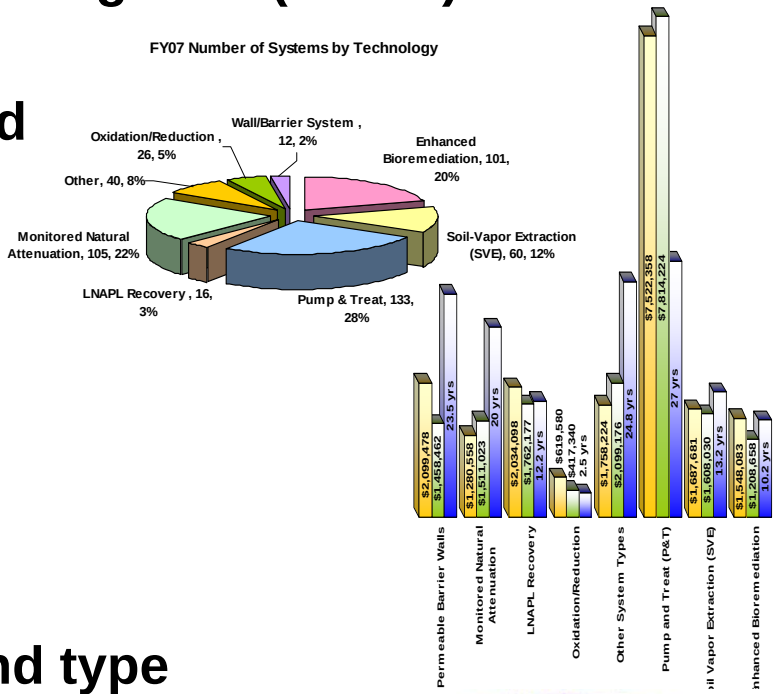
Low Energy Tool – EDITT

Environmental Decision Information Tracking Tool (EDITT)

- AF enterprise database
  - System & technology inventory and performance data
  - Site inventory, green and sustainable transformation
  - Land use control data
  - Decision document inventory
  - Optimization and emerging Issues
- Results
  - Better understanding of number and type of remediation systems/LTM, and O&M cost for each
  - *Flags systems not GSR-oriented for focused optimization/evaluation*



Low Energy Technologies

Goals

- Accelerate greener Remedy-in-Place (RIP)
- Augment current remedies to achieve Response Compete (RC)
- Lower capital and O&M costs
- Move from energy-consumptive to energy-efficient technologies
- Promote education and transfer of successful solutions and lessons learned

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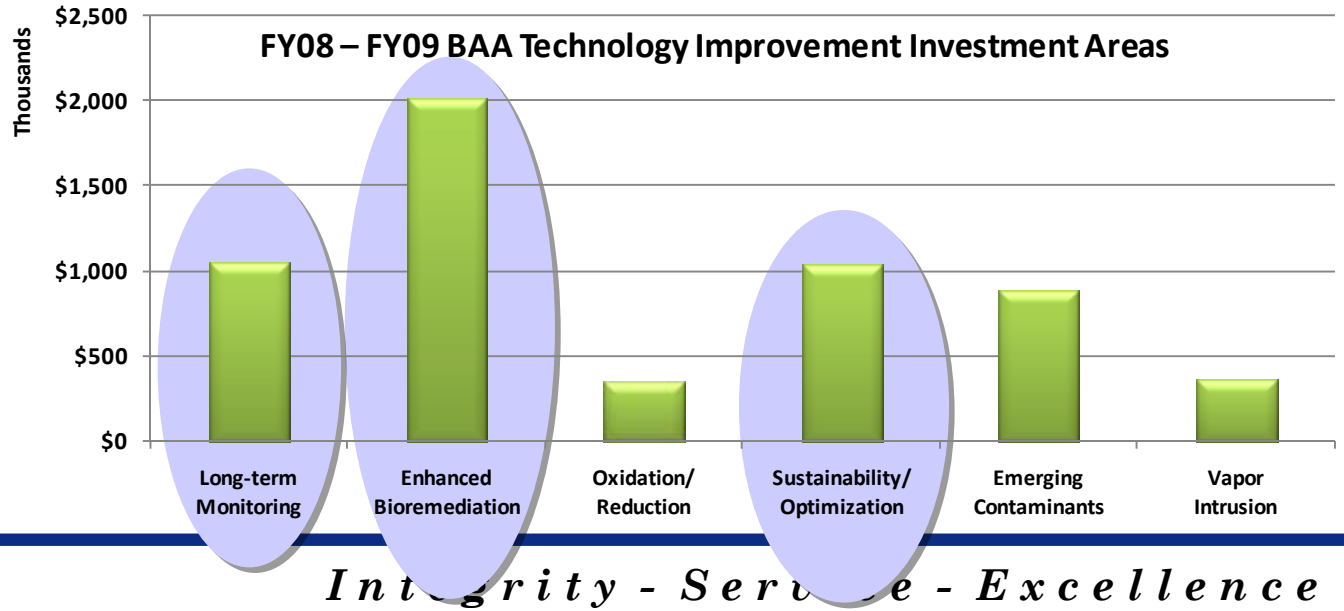
Low Energy Technologies

Broad Agency Announcement (BAA) for USAF Environmental Restoration Program Innovation

- **Contract mechanism for dem/val of innovative technologies**
  - **Identify BETTER, FASTER, CHEAPER, & GREENER solutions**
  - **Appears in FedBizOps**
  - **Awards based on: technical merits and broad spread application**
  - **$3M-$4M/yr AFCEE -- leveraged -- $36M (total) SERDP/ESTCP**




Solar-powered aerator, KSC, FL


Vegetable oil injection, Dover AFB, DE


Biowall, Altus AFB, OK


Solar-powered extraction well, Travis AFB, OK

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Low Energy Technology – Altus AFB, OK

Biowall

- **Primary objective – degrade TCE & other chlorinated compounds as pass through biowall**
- **Interim corrective action to replace P&T system**
- **Reductions in TCE averaging 86 percent**
- **System has been replenished**

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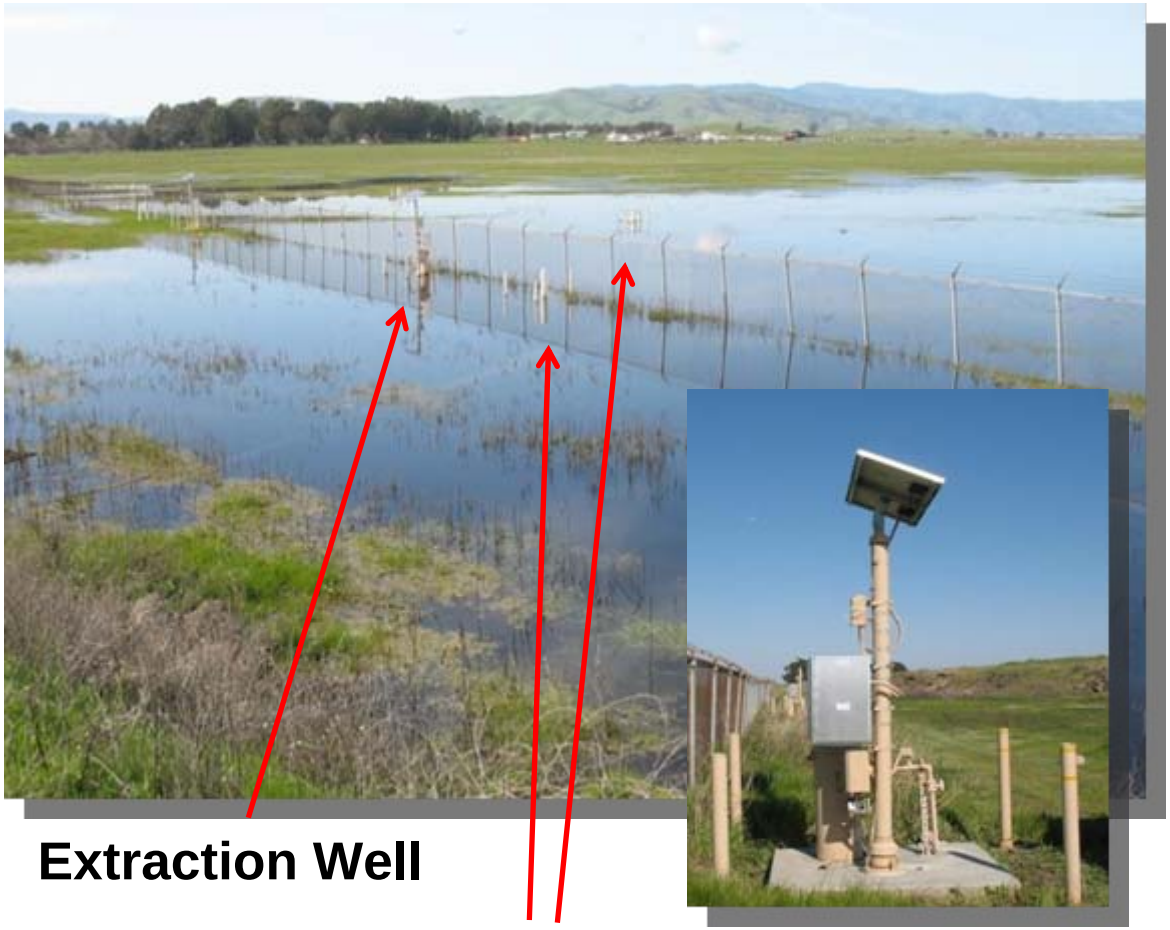
Low Energy Approach – Travis AFB, CA



- **Solar-powered well at base boundary**
  - **Example of GSR out of necessity**
  - **Vernal pool covers most of on- and off-base site boundary**
  - **Solar solution avoided regulatory hurdles and reduced impact on sensitive ecosystem**

Low Energy Approach – Travis AFB, CA

Central treatment plant after optimization

- **Turned off electricity intensive UV/Ox system**
- **Utilized two existing 20K lb canisters**
- **Significant reduction in electricity consumption and O&M costs**

Low Energy Technology – Travis AFB, CA

Solar-powered biological/chemical source area treatment system – in situ bioreactor

- **Mix mulch, gravel, iron and gypsum promote reductive dechlorination and abiotic reduction**
- **Selected as GSR case study by EPA Region 9**

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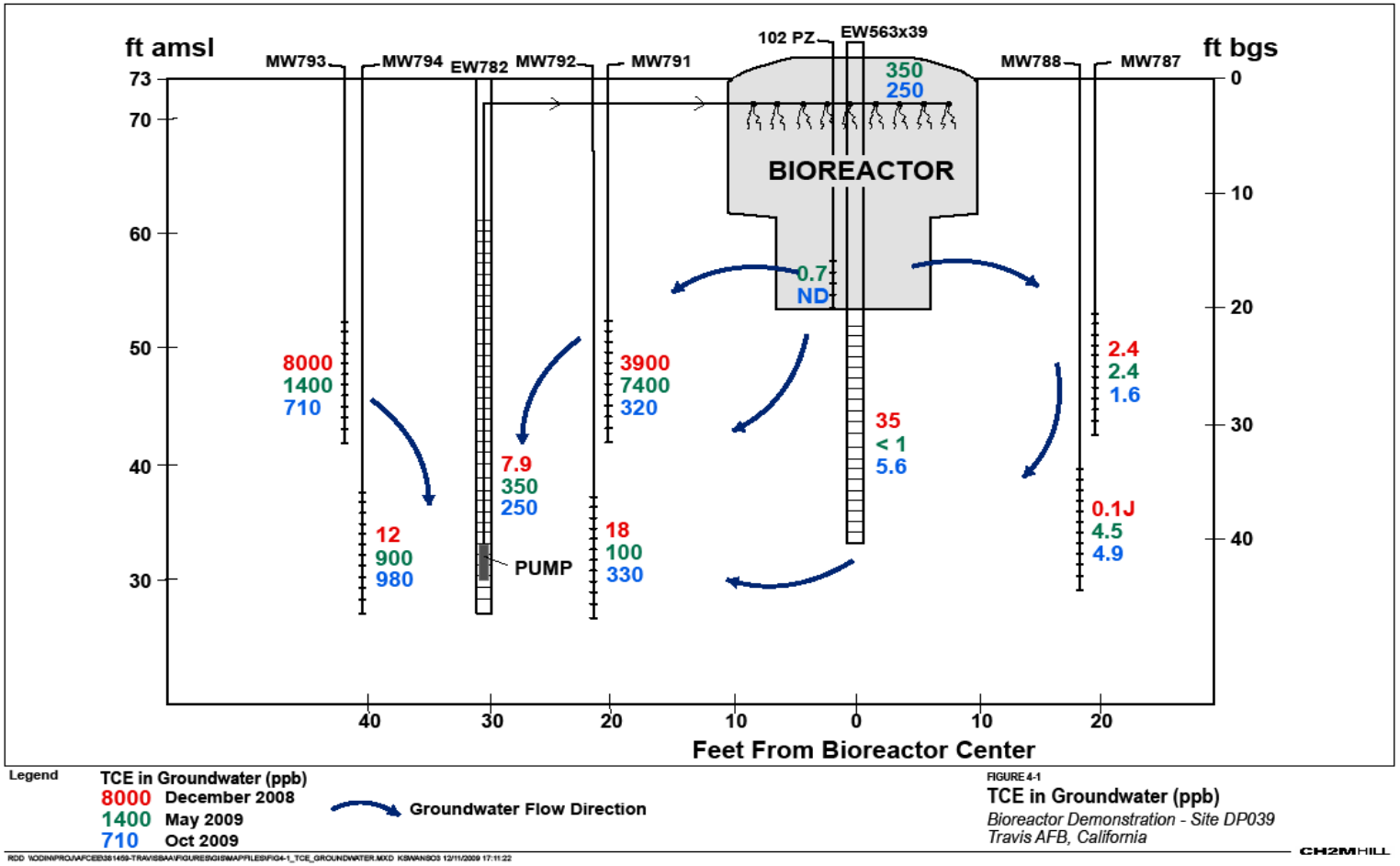
Low Energy Technology – Travis AFB, CA

In situ bioreactor



Low Energy Technology – Travis AFB, CA

Phytoremediation

- **Engineered planting of 380 eucalyptus trees across solvent plume**
- **Plume impact evaluated over 12-year period**
- **Results support inclusion of trees as part of GW treatment train**

Low Energy Approaches – MMR

Easy pickin's

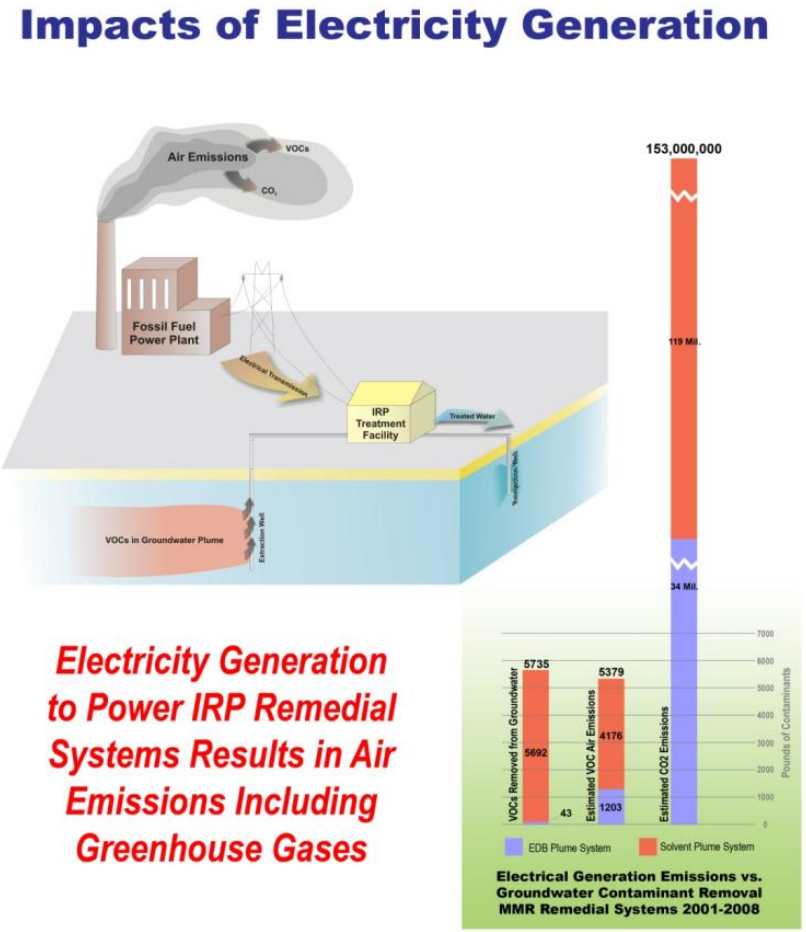
- **Installed more efficient motors = >$100K***
- **Replaced sodium vapor overhead lighting = $53K***
- **Eliminated booster pumps and downsized pump motors = >$45K***
- **Used bio-diesel = $2K***
- **Reduced propane use = $1.5K***
- **Installed low-wattage heaters = $500***
- **Misc energy (motion sensors, lighting replacement, programmable thermostats, LED exit lighting, etc.) = $170***
- **Signed up with load reduction program (demand response program)**

*Dollars Represent Estimated Annual Savings

Low Energy Technology – MMR

Wind turbine

- **Energy audits and sustainability assessments**
- **8 P&T systems remediate 15-16M gal per day**
- **77M kWh, costing $9.6M ’01 - ‘07; $2M in 2007**
- **54,570,560 lbs CO_2 produced**
- **2208 lbs VOCs produced**
- **Annual consumption = power to ~ 1,000 homes**



Low Energy Technology – MMR

Wind turbine construction ('07 – '09)

- **Contract awarded Sep 2007, $4.6M**
- **Produce ~ 3,810 MWh yearly (29% capacity factor)**
- **Annual load from treatment systems ~ 12,300 MWh**
- **Expectations:**
  - **Generate 25-30% total electrical requirement**
  - **Reduce air emissions 25-30%**
  - **Payback anticipated in 6-8 years**
- **Massachusetts Technology Collaborative (MTC) Grant of $300K awarded to AF**

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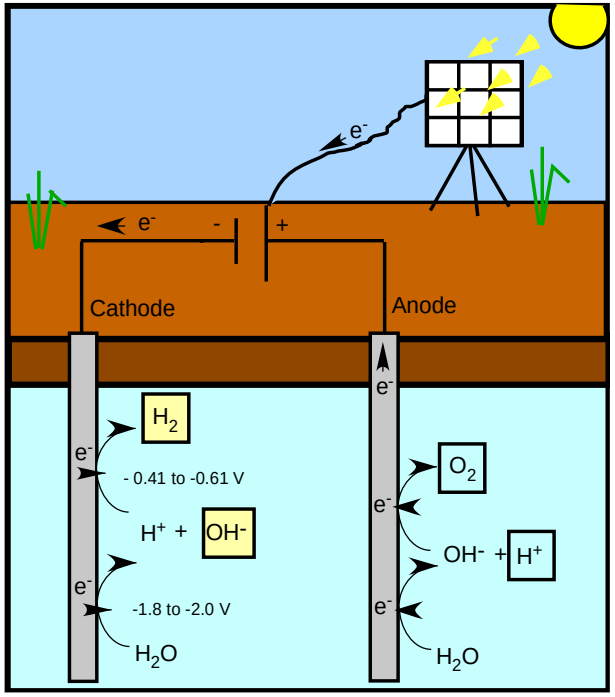
Low Energy Technology – ESTCP ER-201033

Solar-powered Remediation and pH Control

- **Demo treating low pH aquifers with chlorinated solvents**
- **Uses solar-powered electrodes to consume hydrogen ions (i.e., acid) from groundwater and produce H_2 as electron donor**
- **Done at low voltage (<2 V) & current (<1 A)**
- **Can be applied in remote areas or operated for extended periods at low cost and low environmental impact**
- **At higher voltages can split water to produce OH^- ions and H_2 and consume great amounts of acid to allow neutralization of aquifers not feasibly neutralized using common buffers**



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Low Energy Technology – ESTCP ER-0719

Combine Low-energy Electrical Resistive Heating with Biotic and Abiotic Reactions for Treating Chlorinated Solvent DNAPL Sources

- **Objective – Demo benefits of combining low-energy ERH with either ISB or iron-based reduction using injectable ZVI; Examine:**
  - **Extent to which contaminant degradation is enhanced during heating compared to ambient temperatures**
  - **Relative contribution of biotic and abiotic contaminant degradation mechanisms at different temperatures**
  - **Cost-benefit of applying low-energy heating with in situ treatments**
- **Expected to provide more rapid source area cleanup than the in situ technologies alone but without high cost of conventional ERH associated with boiling entire water column and extracting and treating contaminants at surface**

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Fore more information

AFCEE Technology Transfer:

Erica Becvar, 210-395-8424, erica.becvar.1@us.af.mil

AFCEE ERP-O Website
www.afcee.af.mil/resources/restoration/rpo/index.asp

AFCEE Sustainable Remediation Web Site
www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremeditation/index.asp

EPA on Green Remediation
www.clu-in.org/greenremediation/

ITRC on Green Sustainable Remediation
www.itrcweb.org/teampublic_GSR.asp

ESTCP and SERDP Projects
www.estcp.org and www.serdp.org

Questions?