Greener Cleanups

National Summary
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Gary Victorine
Land and Chemicals Division
&
Brad Bradley
Superfund Division

USEPA Region 5

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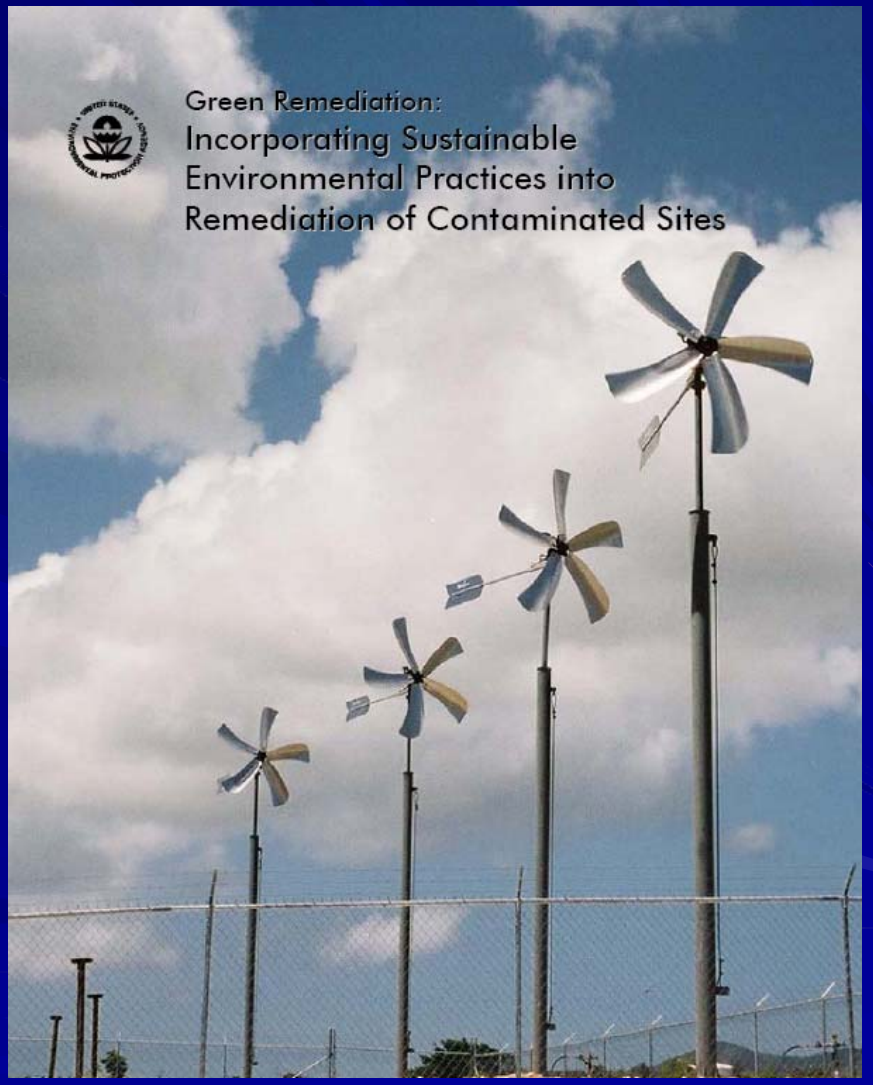
Greener Cleanups

- Tools
- Strategies
- Policies
- Activities

EPA Green Remediation Primer

- Released April 2008
- Provides intro to best practices; examples of how and where they are used
- Focuses on remedy implementation across regulatory frameworks



United States Environmental Protection Agency | Office of Solid Waste and Emergency Response (5102G) | EPA 542-F-08-012 December 2008

Green Remediation: Best Management Practices for Excavation and Surface Restoration

Office of Superfund Remediation and Technolo

This fact sheet is one of a series describing management practices (BMPs) for green re which holistically addresses a cleanup proj energy requirements, (2) air emissions, (3) water, (4) material consumption and waste (5) impacts on land and ecosystems, and (stewardship actions. BMPs can be used fo removal or cleanup activities at contaminat under Superfund, corrective action, underg storage tank, and brownfield cleanup prog

Some green remediation strategies stem fr environmentally progressive practices of bu market sectors such as construction. Othe elements such as green purchasing into tra practices of the remediation sector. Yet m BMPs incorporate innovative technologies readily adapted to increase cleanup sustain

Overview

Excavation in varying degrees is often unde contaminated sites to:

- Address immediate risk to human health environment as part of immediate or lon removal actions
- Prepare for implementation of in situ or remediation technologies, which often in building or other structural demolition
- Address soil or sediment hot spots for wh remedies may be infeasible due to extren cost, long duration, or technical constrai

Many opportunities exist to reduce the neg of excavation, which commonly include soi high rates of fuel consumption, transport o contaminants, uncontrolled stormwater run disposal of excavated material, and ecosys disturbance. Decisions regarding excavati and targets affect follow-up land and surfa restoration strategies as well as ultimate lo

Planning for Excavation and Reste

Early and integrated project planning allow (typically early) excavation period to set the sharing of resources, infrastructures, and p throughout site cleanup and reuse. Early E

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response (5102G) | EPA 542-F-09-004 December 2009

Green Remediation Best Management Practices: Site Investigation

Office of Superfund Remediation and Technology Innovation

The U.S. Environmental Protection Agency (EPA) Principles for Greener Cleanups outlines the Agency's policy for evaluating and minimizing the environmental "footprint" of activities undertaken when cleaning up a contaminated site.[1] Use of the best management practices (BMPs) recommended in EPA's series of green remediation fact sheets can help project managers and other stakeholders apply the principles on a routine basis, while maintaining the cleanup objectives, ensuring protectiveness of a remedy, and improving its environmental outcome.[2]

Overview

The need for site investigation is common to cleanups under any regulatory program. An investigation can occur at all points in the cleanup process, from initial site assessment through waste site closeout. A site investigation generally is undertaken to:

- Confirm the presence or absence of specific contaminants
- Delineate the nature and extent of environmental contamination
- Identify contaminant sources
- Provide the data necessary to assess potential risk to human health and/or the environment
- Gather the data needed to determine if a remedial action should be taken
- Understand site characteristics impacting the remedy design, construction, or operation and closeout, and
- Evaluate performance of a remedial action.

Site investigations typically involve sampling of soil and groundwater using various drilling and well installation technologies and analysis of samples at offsite laboratories. Investigations also may include sampling of sediment, surface water, soil gas, or indoor air; searching for underground storage tanks (USTs) or other buried objects; or evaluating demolition material containing asbestos, lead-based paint, or other toxic products.

Planning for Site Investigation

Consideration of green remediation options early during the project design phase will help reduce cumulative environmental footprints of a cleanup. Effective planning will include identification of investigative decision points in context of a site's unique contamination scenario and logistics, while accounting for potential remedies and anticipated site reuse.

At each decision p evaluated to deter core elements of a

- Reducing total e increasing renew use
- Reducing air poll greenhouse gas emissions
- Reducing water negative impacts
- Improving materi efforts, and
- Enhancing land protection.

A green site inves from a thorough target areas and intrusive techniques direct sensing to footprint of follo activities, particular and increasing th targeted remedial also can be achi sampling tools duri

Initial BMPs for a si

- Evaluating feasib analytical metho
- Scheduling activi delays caused b for heating or co
- Identifying local and vehicles and
- Establishing elec deliverables, t preparation, and basis of compari Environmental As
- Selecting facilit accommodations
- Reducing travel compressed wor and
- Identifying optio resources, incl cleanup activities

1

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response (5102G) | EPA 542-F-09-005 December 2009

Green Remediation Best Management Practices: Pump and Treat Technologies

Office of Superfund Remediation and Technology Innovation | Quick Reference Fact Sheet

The U.S. Environmental Protection Agency (EPA) Principles for Greener Cleanups outlines the Agency's policy for evaluating and minimizing the environmental "footprint" of activities undertaken when cleaning up a contaminated site.[1] Use of the best management practices (BMPs) recommended in EPA's series of green remediation fact sheets can help project managers and other stakeholders apply the principles on a routine basis, while maintaining the cleanup objectives, ensuring protectiveness of a remedy, and improving its environmental outcome.[2]

Overview

Pump and treat (P&T) technology typically is selected in a cleanup remedy to hydraulically contain contamination and/or restore an aquifer to beneficial use. Opportunities to reduce the energy and environmental footprint of a P&T remedy, which are available during site characterization and the remedy selection, design, construction, and operation phases, rely on effective planning and continual re-evaluation of P&T operations. Options for reducing the footprint vary based on the site conditions and cleanup objectives as well as the configuration and components of a planned or existing P&T system. Effective footprint reduction activities will complement the cleanup objectives while aligning with related guidelines such as Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance.[3]

P&T remedies often operate for long periods, in some cases decades, due to the nature of the technology and the nature of contaminant transport in the subsurface. As a result, operation of a P&T system, compared to system construction, can contribute significantly to the energy and environmental footprint of a P&T remedy. The best opportunities typically relate to optimizing efficiency of long-term operations, particularly in terms of energy and other natural resource consumption.

Continuous motor operation under load (for pumps, blowers, and other machinery) during a 30-year period of operation uses over 260,000 kWh of electrical energy per motor horsepower or over 2.7 billion BTUs of energy per motor horsepower (hp). This amount of energy is equivalent to the electricity used by more than 22 homes over one year.

Illustration of a P&T system with a fairly complex treatment process indicates how a system relates to each of the five core elements of green remediation. Components in this example can be removed to focus on how a simpler P&T system could affect the environmental footprint during operations.

P&T Component	Examples of Environmental Effects During a Complex P&T Operation
Groundwater Extraction	• Energy use (and associated air emissions) caused by generating electricity from fossil fuels to power extraction pumps • Materials use for well construction, maintenance, and rehabilitation • Removal of contaminated water and protection of other groundwater • Potential dewatering of wetlands and disrupting wetland ecosystems located near extraction wells
Process Equalization	• Energy use (and air emissions) for pumps used to adjust pressures among treatment components
Metals Removal (chemical addition, precipitation, sorting, filtration, and solids handling)	• Energy use (and air emissions) for electricity operating mixer motors and filter feed or solids handling pumps • Materials use from chemical addition • Waste disposal from removed solids, such as metals or biosolids • Infringement on land and ecosystems from landfill space for waste disposal
Air Stripping	• Energy use (and air emissions) for electricity to operate a blower • Materials use for chemical cleaning of a stripping system
Off-Gas Treatment and *Granular Activated Carbon Filtration*	• Energy (and air emissions) for electricity to preheat off-gas prior to vapor treatment • Materials and potential waste disposal for granular activated carbon
Effluent Tanks	• Energy use (and air emissions) for electricity to pump water across a multi-step treatment process
Discharge to Surface Water	• Net withdrawal of local groundwater resources when extracted water is discharged to surface water
Building Operations	• Energy use (and air emissions) for electricity to power lights, ventilate a building, and potentially provide heat
Long-Term Operation	• Effects on land use and the local community and long-term stewardship of land and nearby ecosystems

1

Upcoming Greener Cleanup BMPs

- Bioremediation
- Soil Vapor Extraction and Air Sparging
- Clean Fuel Technology at Cleanup Sites
- Landfills
- In-situ Chemical Treatment
- In-situ Thermal Technologies
- Integrating Renewable Energy into Site Cleanup

Green Remediation Focus

Considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprints of a cleanup

Home

In the News

- EPA releases fact sheets on BMPs for **site investigation (PDF)** (4 pp, 179.12KB) and **pump & treat technologies (PDF)** (8 pp, 224.95KB)
- EPA issues **Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects**
- Northwest Environmental Training Center offers January course on **EPA's construction site stormwater discharge limits and BMPs**
- Metrics, optimization, and case studies of green/sustainable remediation will be addressed at the May 2010 International Conference on

GR Technology Primer (PDF) (56 pp, 814K): Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites

GR Best Management Practices

- **An introduction** (PDF) (2 pp, 141K)
- **Excavation and surface restoration** (PDF)

The Policies & Strategies

- Principles for Greener Cleanups
- Superfund Green Remediation Strategy
- Region 2 Clean & Green
- Region 5 Greener Cleanups
- Region 9 Greener Cleanups
- Region 10 Clean & Green

Incorporating the BMPs into ...

- Design, construction, & operations
- Renewable energy application
- System optimization

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Engineering Forum

The Engineering Forum is a group of Engineers and other Technical Support Staff that support the Superfund and RCRA programs in each of the ten EPA Regional Offices. The group was organized to exchange up-to-date information related to engineering remediation issues at Superfund and RCRA sites. Additional participants come from the EPA Laboratory System and EPA Headquarters. The Forum promotes communication between the Regions and the Laboratories and has three primary purposes. First, to bring the current state-of-the-science to each regional office as it is developed through the research efforts at the labs. Second, to focus laboratory resources on research areas important to engineers and technical support staff working in each EPA Region. Finally, the Forum works to maintain consistency in the interpretation of guidance and application of policy throughout the country.

- Teleconference Minutes for Engineering Forum
- Engineering Forum Membership List
- Engineering Forum Strategic Plan (PDF) (2pp/107KB, About PDF)
- Engineering Forum Brochure (current as of July 2008) (PDF) (14pp/246KB, About PDF)
- Engineering Forum Issue Papers
- Engineering Forum Roundtable Notes
- Engineering Forum Links of Interest

Site maintained by: Technology Innovation Program, Office of Superfund Remediation and Technology Innovation, Office of Solid Waste and Emergency Response
fiedler.linda@epa.gov

Introduction to Energy Conservation and Production at Waste Cleanup Sites

ENGINEERING FORUM ISSUE PAPER

Michael Gill* and Katarina Mahutova**

1.0 Abstract

The U.S. Environmental Protection Agency (EPA) has always worked to improve management of hazardous waste cleanup projects. Net energy savings through conservation and energy production is one strategy for improvement. Presidential Executive Order 13123, "Greening the Government Through Efficient Energy Management," states that each federal agency shall strive to expand the use of renewable energy within its facilities and in its actions by implementing renewable energy projects.(1)

* U.S. EPA Region 9 / SFD-84
75 Hawthorne Street
San Francisco, CA 94105

** U.S. EPA Region 10
1200 6th Ave (OEA-095)
Seattle, WA 98101

EPA has prepared this issue paper to raise awareness and help project managers recognize the need to consider energy conservation and production during the design and operation and maintenance (O&M) of waste cleanup projects. These include projects initiated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) commonly known as Superfund, the Resource Conservation and Recovery Act (RCRA), and by EPA's Underground Storage Tank (UST) and Brownfields waste clean up programs.

Although energy conservation is an important priority, meeting remediation goals is the most important. However, with more than one way to reduce energy use, the ability to meet remediation goals and operate cleanup projects efficiently can be accomplished.

2.0 Background

This issue paper was developed by EPA's Engineering Forum, with support from the U.S. Army Corps of Engineers (USACE), to help EPA and other project managers consider ways to conserve and produce energy at waste cleanup sites. The Engineering, Federal Facilities, and Ground Water Forums, established by EPA professionals in the ten regional offices, are committed to identifying and resolving scientific, technical, and engineering issues impacting the remediation of

Solid Waste and Emergency Response (5102G)

EPA 542-S-04-001
May 2004
www.epa.gov/tio/tsp

OSWER

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response

Principles for Greener Cleanups

Protecting Communities and the Environment for a Sustainable Future
As a nation, we value land as a natural, cultural, and economic resource. Cleaning up contaminated land protects human health and the environment and enables communities and other stakeholders to pursue future beneficial use or reuse of resources for economic, environmental, and societal purposes. Prevention and remediation of contamination plays a central role in seeking a sustainable future.

A goal of the U.S. Environmental Protection Agency (EPA) Office of Solid Waste and Emergency Response (OSWER) and its many partners is to preserve and restore land by promoting and using protective waste management practices and by assessing and cleaning up contaminated sites. OSWER cleanup programs (including national and regional programs) address contaminated soil, groundwater, surface water, sediments, air, and other environmental media.

EPA cleanup programs include common elements such as an initial site assessment, initial site stabilization when needed to protect against imminent threats, site characterization, cleanup option evaluation, selection, and implementation, and when appropriate, longer-term management of the site. When done in close consultation with local communities, these cleanup programs not only protect human health but also allow communities and other stakeholders to promote beneficial, protective future uses of the property.

Doing our Work Smarter – and Greener
Cleaning up sites can be viewed as "green" from the perspective of the cleanup improving environmental and public health conditions. However, cleanup activities use energy, water and materials resources to achieve cleanup objectives. The process of cleanup therefore creates an environmental footprint of its own. Over time, we have learned that we can optimize environmental performance and implement protective cleanups that are **greener** by increasing our understanding of the environmental footprint and, when appropriate, and taking steps to minimize that footprint.

OSWER cleanup programs should consider these Principles for Greener Cleanups during any phase of work, including site investigation, evaluation of cleanup options, and optimization of the design, implementation, and operation of new or existing cleanups. All cleanup approaches, and all elements of the cleanup process, can be optimized to enhance their overall environmental outcome; therefore, green remediation involves more than merely adopting a specific technology or technique.

These Principles for Greener Cleanups are not intended to allow cleanups that do not satisfy threshold requirements for protectiveness, or do not meet other site specific cleanup objectives, to be considered greener cleanup. The Principles are not intended to trade cleanup program

OSWER Workgroups

- Green Remediation, Reuse, and Redevelopment Team;
- National Greener Cleanups Metrics Workgroup;
- RCRA Reuse and Brownfields Prevention Workgroup;
- Superfund National Green Remediation Workgroup.

U.S. ENVIRONMENTAL PROTECTION AGENCY

National Clean Diesel Campaign

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  - Clean Agriculture
  - Clean Construction
  - Clean Ports
  - Clean School Bus
  - SmartWay Transport
- State & Local Toolkit
- Quantifier
- Newsroom
- Publications
- Regulatory Programs
- Compliance Help
- Related Links

Clean Diesel Program Quick Finder

Grants & Funding	Technologies	Resources: Help Line — 1-877-623-2322
2009 Opportunities	Verified Technology List	Diesel Emissions Quantifier (DEQ)
NCDC Funded Projects	Emerging Technologies	Regional Collaboratives
Funding Archive	Idle Reduction Technologies	Tools & Resources

National Clean Diesel Campaign

Why Clean Diesel?

Reducing emissions from diesel engines is one of the most important air quality challenges facing the country today. EPA established the National Clean Diesel Campaign (NCDC) to promote diesel emission reduction strategies. NCDC includes regulatory programs to address new diesel engines as well as innovative programs to address the millions of diesel engines already in use.

Diesel engines power the movement of goods across the nation, help construct the buildings in which we live and work, help build the roads on which we travel, and carry millions of children to school each day. While diesel engines provide mobility and are critical to the nation's economy, exhaust from diesel engines contains pollutants that negatively impact human health and the environment. Diesel engines emit large amounts of nitrogen oxides, particulate matter and air toxics, which contribute to serious public health problems.

NCDC's Innovative Strategies

More than 20 million diesel engines in operation today do not meet EPA's new clean diesel standards, yet these engines can continue to operate for 20 to 30 years. EPA established innovative programs to accelerate emission reductions from older diesel engines to provide more immediate air quality benefits. The goal of these innovative programs is to address in-use diesel engines by

Clean Diesel Report to Congress

Report to Congress highlights first year of clean diesel program successes.

EPA Recovery Act

$300 million in funding from the American Recovery and Reinvestment Act 2009 has been distributed to support clean diesel activities.

Clean Diesel Helpline

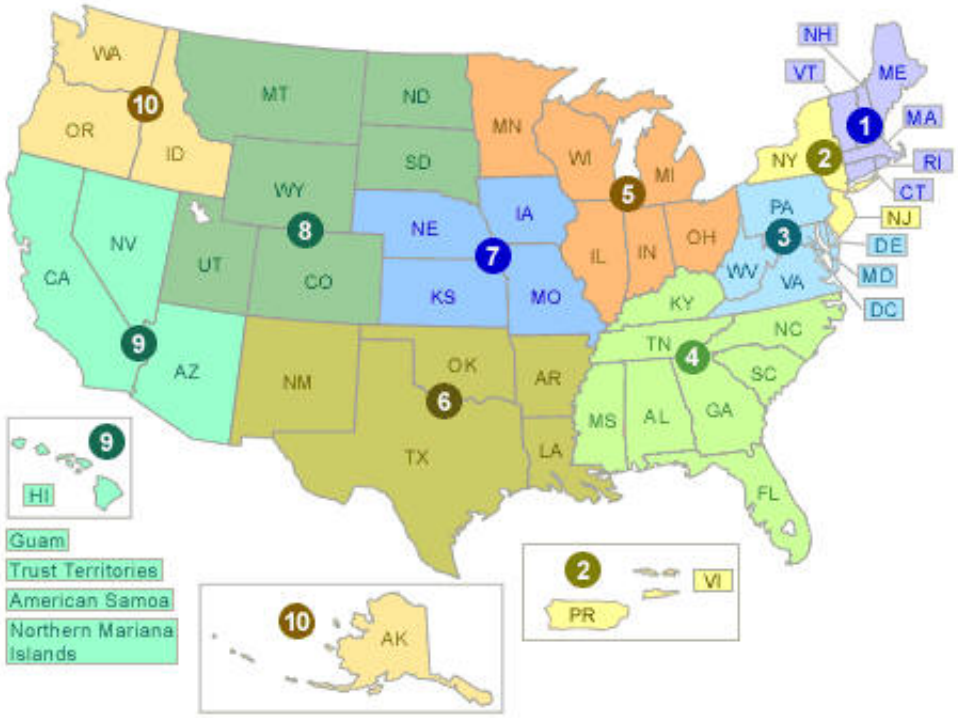
Answers about clean diesel funding and technologies typically provided within one business day. Technical support available at:

1-877-NCDC-FACTS
(1-877-623-2322)

E-mail:
cleandiesel@epa.gov

Clean Diesel Tools and Resources

E-mail Updates



Regional Clean Diesel Collaboratives

The clean diesel collaboratives are public-private partnerships working to improve air quality by reducing diesel emissions through projects that use innovations in diesel engines, alternative fuels and renewable energy technologies. Working together allows members to leverage funding, share technology and professional expertise.

- Northeast Diesel Collaborative (EPA Regions 1, 2) EXIT Disclaimer
- Mid-Atlantic Diesel Collaborative (EPA Region 3) EXIT Disclaimer
- Southeast Diesel Collaborative (EPA Region 4) EXIT Disclaimer
- Midwest Clean Diesel Initiative (EPA Region 5)
- Blue Skyways Collaborative (EPA Regions 6, 7 plus Minnesota) EXIT Disclaimer
- Rocky Mountain Clean Diesel Collaborative (EPA Region 8)
- West Coast Collaborative (EPA Regions 9, 10, w/Canada and Mexico) EXIT Disclaimer

U.S. EPA Regions

Regional Cross-Program Greener Cleanup Policies:

- Region 2: March 17, 2009
- Region 10: August 13, 2009
- Region 7: September 8, 2009
- Region 9: September 14, 2009
- Region 5: November 12, 2009
- Region 3: January 7, 2010

U.S. EPA Regions

- Region 3
  - National Standards for Green Cleanups;
  - Greener Cleanups Symposium Feb 10-11.
- Region 9
  - Life Cycle Analysis of Greener Cleanup Alternatives;
  - Smart Energy Resources Guide (2008).

U.S. EPA Regions

- Region 5
  - Greener Cleanups Interim Policy
  - Training
  - Pilots
  - Web Page
  - This meeting

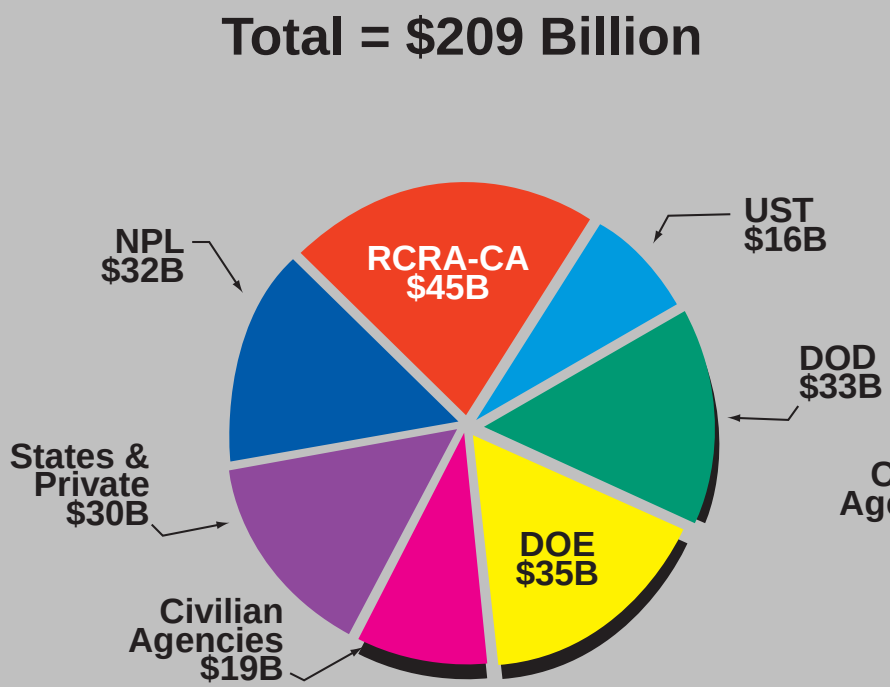
Green Remediation at EPA

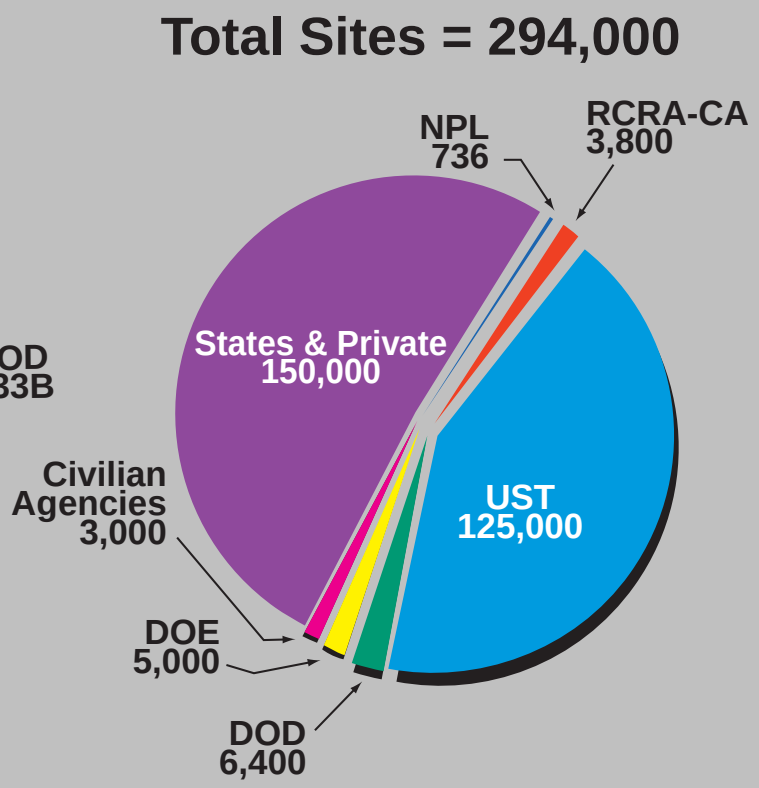
Update on Superfund Strategy

Brad Bradley
bradley.brad@epa.gov

There's Still Much Work to Do

Estimated Number of Sites and Cleanup Cost 2004-2033*





*http://cluin.org/market

Superfund Green Remediation Strategy: Overview

- Sets out the Superfund Program's plans to promote green remediation practices during site cleanups without compromising cleanup goals
- Covers three areas:
  - Policy and Guidance
  - Resource Development and Program Implementation
  - Evaluation
- Includes 10 "Key Actions"; each action includes several implementation activities (46 total)

Superfund GR Strategy
10 Key Action Items

1. Clarify the role of green remediation in remedy selection, and recommend potential statutory and regulatory changes
2. Develop a compendium of practices and tools to help project and Program managers integrate green remediation practices
3. Develop Program incentives to encourage use of green remediation practices
4. Address air pollutants and diesel emissions
5. Develop pilot projects to evaluate and demonstrate green remediation applications

Superfund GR Strategy 10 Key Action Items (continued)

6. Establish incentives to encourage contractors, assistance agreement recipients, and others to use green remediation practices
7. Communicate and share success stories and lessons learned among “implementers” across the Program and the public
8. Evaluate green remediation application at the site level
9. Develop Program evaluation measures
10. Evaluate the Superfund Green Remediation Strategy

Green Remediation Activities Underway

- Baselines, measures, and metrics
- Multiple cross-program and regional workgroups
  - CCCL (plus subgroups)
  - GCS (plus subgroups)
  - Superfund GR (plus subgroups)
- Collaboration with FRTR, ITRC, ASTSWMO
- Engineering Forum “GR review and technical support” capability
- New incentives (ER3, States, etc).
- Model contract and enforcement provisions
- Remedy-specific green remediation “cheat sheets’

More Information

http://www.cluin.org/greenremediation

www.epa.gov/superfund/greenremediation