PUBLIC REVIEW VERSION

Superfund Green Remediation Strategy

August 2009

9351184

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Office of Superfund Remediation and Technology Innovation

024578

Acknowledgments

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Executive Summary

As part of its mission to protect human health and the environment, the U.S. Environmental Protection Agency (EPA, or "the Agency") and its partners manage and implement the Superfund Remedial Program ("the Program"), which is dedicated to the cleanup of the nation's uncontrolled hazardous waste sites. Since its inception in 1980, the Program (which includes the Office of Superfund Remediation and Technology Innovation (OSRTI), the Federal Facilities Restoration and Reuse Office (FFRRO), the Federal Facilities Enforcement Office (FFEO), the Office of Site Remediation Enforcement (OSRE), the Office of Emergency Management (OEM), and EPA regional Superfund offices) has made considerable progress toward cleaning up hazardous waste sites and responding to emergencies involving hazardous substances. Site remediation involves a wide variety of approaches and technologies to address contamination in soil, ground water, surface water, and sediment. This *Superfund Green Remediation Strategy* ("the Strategy") sets out current plans of the Superfund Remedial Program to reduce greenhouse gas (GHG) emissions and other negative environmental impacts that might occur during remediation of a hazardous waste site or non-time critical removal actions.

Today, we recognize that the activities associated with investigation and remediation of hazardous waste sites may be sources of GHGs, diesel emissions, air pollutants, and other emissions. For example, treatment remedies, such as pump and treatment systems for contaminated ground water, may use energy from fossil fuel powered utilities for many years. Similarly, heavy-duty equipment used during site remediation is usually powered by diesel fuel, which typically emits a complex mixture of air pollutants. At many sites, we are recognizing that much can be done to reduce the energy use and improve the environmental performance of Superfund activities, while at the same time fulfilling our mission to protect human health and the environment.

Green remediation is the practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprints of cleanup actions.

In September 2008, OSRTI formed a workgroup of headquarters and regional staff to develop a green remediation strategy. This current version of the Strategy is the culmination of workgroup discussions regarding ways that the Superfund Remedial Program may reduce the environmental "footprint" of response actions taken at private and federal sites, while at the same time protecting human health and the environment. This Strategy is not intended to be a comprehensive document; rather, we expect it will change over time as we learn more about how we can improve our cleanup activities and receive input from others.

This current version of the Strategy outlines ten key action items and recommends related activities to promote green remediation. Action items fall into three overarching categories:

- Policy and guidance development;
- Resource development and program implementation; and
- Program evaluation.

Recommended Key Actions

Key Action	Description
Policy and Guidance Development	
Key Action #1	Clarify the role of green remediation in remedy selection and implementation
Resource Development and Program Implementation	
Key Action #2	Develop a compendium of protocols and tools to help project and Program managers integrate green remediation practices
Key Action #3	Identify options that enable use of green remediation practices
Key Action #4	Address air pollutants and diesel emissions
Key Action #5	Develop pilot projects to evaluate and demonstrate green remediation applications
Key Action #6	Establish opportunities in contracts and assistance agreements to identify green remediation practices in selected remedies
Key Action #7	Communicate and share success stories and lessons learned among "implementers" across the Program and the public
Program Evaluation	
Key Action #8	Evaluate green remediation application at the site level
Key Action #9	Develop Program evaluation measures
Key Action #10	Evaluate the Superfund Green Remediation Strategy

In developing these action items, the workgroup highlighted several needs that are important for their implementation:

- Clarify how green remediation practices fit within the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP);
- Improve our understanding of potential resource and energy demands for many Superfund remedies; and
- Develop a consensus on metrics that can be used to measure and evaluate green remediation actions.

This Strategy contains recommendations to develop white papers that clarify major issues such as the extent to which OSRTI, FFRRO, FFEO, OSRE, and Superfund regional programs can incorporate green remediation practices under existing laws and regulations. The Strategy also includes a recommendation to pursue follow-on directives that help foster greater use of green remediation practices at Fund-lead (i.e., sites where cleanup is funded by the Agency and led by EPA), state-lead, potentially responsible party (PRP)-lead, and federal facility sites.

The Strategy recommends a series of initiatives that may be implemented in the near term to expedite consideration and use of green remediation practices:

- Launching a pilot project to test incorporating green remediation considerations into remedy optimization evaluations by fiscal year 2010;
- Considering ways to reduce the use of natural resources and energy during remedial actions and when developing cleanup alternatives;
- Integrating clean, renewable, and innovative energy sources and advanced diesel technologies (such as diesel particulate filters and alternative fuels) and encouraging operational practices (such as engine idle reduction practices) to minimize total emissions;
- Including language in statements of work for Fund-lead remedial and removal action and PRP-lead remedial design and remedial action contracts that specifies use of green remediation practices and requires separate reports for energy/fuel usage and costs; and
- Helping communities establish networks and training programs that enable local workers (including minority and low-income populations) to gain proficiency in expertise needed for green cleanups, such as energy efficiency auditing and renewable energy applications.

Finally, the Strategy includes the recommendation to establish a process for quantifying achievements regarding the Program's commitment to reduce the demands that site cleanups place on the environment. Regional summaries, site-specific data, and trend information can be collected and used to establish a solid baseline on the environmental demands made prior to Strategy implementation. Using this baseline, the Program could aim toward specific targets such as reducing energy consumption by 20%, increasing use of alternative fuels/renewable energy by 15%, and reducing diesel equipment emission of particulate matter by 10% by 2015, to the extent consistent with selecting responses under the NCP.

As a "living" document, OSRTI will update this Strategy to reflect refined Agency policy, modified activities within the key actions, and other developments as green remediation matures. EPA is seeking input from Superfund "stakeholders" (including affected communities, state and local governments, tribal governments, other federal agencies, cleanup contractors, PRPs, and developers). The Agency will conduct specific outreach activities to solicit and promote input on further refining this Strategy and focusing this effort. The Strategy's next version will include aspects specific to the Agency's Emergency Response/Removal Program.

1.0 Introduction

The EPA Superfund remedial offices managing the long-term cleanup of Superfund sites are dedicated to the broader goal of the Agency's mission to protect human health and the environment. These offices strive to clean up hazardous waste sites in ways that use natural resources and energy efficiently and reduce negative impacts on human health and the environment in accordance with existing authorities. This *Superfund Green Remediation Strategy* sets out the Program's current plans to respond to the need to reduce GHG and other air emissions and minimize other negative impacts on the environment and surrounding community that might occur during remediation of a hazardous waste site, while continuing to protect human health and the environment.

1.1 Background

Site cleanup is inherently green; 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. For purposes of this Strategy, EPA defines green remediation as the practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprints of cleanup actions.[1]

Green remediation is intended to reduce the demand placed on the environment during cleanup actions and to conserve natural resources. Each stage of the remedial process (discovery, assessment, characterization, design and construction activities, operation of treatment and containment remedies, monitoring and maintenance of remedies, etc.) produces an environmental footprint. Combined, the footprint can be significant when considering the nearly 10,000 sites yet to reach a final assessment decision along with the approximately 1,600 final and deleted sites on the National Priorities List (NPL). The impacts to the environment and to communities from cleanup activities, including fossil fuel consumption, emission of GHG and air pollutants, disruption to water cycle balances, and soil erosion, need to be considered.

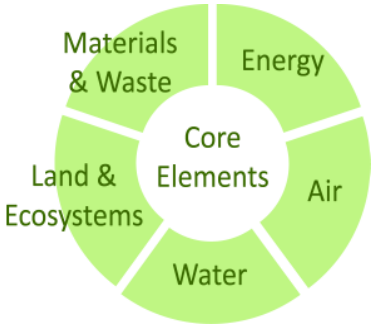
Opportunities to reduce environmental footprints at contaminated sites exist beyond cleanup activities. When green remediation techniques are linked to careful site reuse planning and sustainable development practices, such as applying smart growth principles and green building methods, additional opportunities are often created to reduce the environmental footprint of both remediation and reuse projects. The combined planning and practices provide a basis for a greener approach to land revitalization and help ensure that all socioeconomic groups of affected communities can benefit from the improved environmental outcome of site cleanup.

Green remediation generally is recognized as a major step in improving the sustainability of contaminated land cleanup.[2] EPA's Office of Solid Waste and Emergency Response (OSWER) identified five core elements of green remediation:

- **Energy:** Many Superfund cleanups involve energy intensive technologies. Green approaches focus on opportunities to improve energy efficiency and use renewable energy sources.

[1] Extensive background information is provided in EPA's technology primer, *Incorporating Sustainable Environmental Practices into Remediation of Contaminates Sites* (USEPA, 2008c).
[2] In accordance with Executive Order 13423, sustainability is defined as the capacity to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations of Americans.

- **Air:** Many Superfund cleanups involve onsite and offsite emissions of GHGs and air pollutants from activities such as treatment processes, operation of heavy machinery, and transportation of routine vehicles and cargo trucks. These emissions can be reduced by applying the most appropriate advanced technologies and practices.
- **Water:** Superfund cleanups may also involve consumption of significant amounts of water for treatment processes and typically require management of surface water. Green approaches focus on reducing water consumption, reusing treated water, and using efficient techniques to manage and protect surface water and ground water.
- **Land and ecosystems:** Superfund sites often involve degraded onsite and offsite ecosystems and may have conditions that make the site unsafe for human or other use. Green remediation strategies focus on remedial actions that minimize further harm to the area, protect land resources and ecosystems at or near the site, and foster the return of sites to ecological, economic, social, or other uses.
- **Materials and waste:** Site remediation generally uses significant amounts of raw materials and sometimes generates its own hazardous and non-hazardous wastes, including materials and debris that often are shipped offsite. Green strategies offer opportunities to reduce material consumption and waste generation, use recycled and indigenous materials and spent products, and purchase environmentally preferred products.



1.2 Green Remediation and Superfund

Green remediation aligns with goals and processes outlined in CERCLA (P.L. 96-510, 1980) as well as the NCP (40 CFR 300, Title 40). One of the primary purposes of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 and the Small Business Liability Relief and Brownfields Revitalization Act of 2002, is to protect human health and the environment from uncontrolled hazardous waste sites. As the basic blueprint for carrying out Superfund response actions, the NCP describes expectations for response actions and includes remedy selection considerations such as "the nine criteria" to evaluate alternatives. Green remediation strategies as addressed in this document may also be useful in non-time critical removal actions, including preparation of engineering evaluation/cost analyses (EE/CAs), but may have less applicability in time critical removals, especially emergency response situations.

Opportunities to decrease the environmental footprint of cleanup activities and maximize a cleanup project's total environmental benefit exist throughout a project life, extending from site investigation through development of cleanup alternatives and remedy design, construction, operation, and monitoring. A number of EPA regional offices have initiated efforts to apply green remediation practices during site cleanups.[3] These opportunities are enhanced by recent developments such as advances in cleanup technologies and growing awareness of the links between site cleanup and revitalization. Concerns about fluctuations in energy costs and the growing quantity of GHG emissions have highlighted the need for a smaller environmental footprint. Given these trends, green remediation strategies offer significant potential for increasing the total benefit of a cleanup, potentially saving project costs, and returning sites to productive reuse that is consistent with cleanup goals.

[3] For example, see Region 2's "Clean & Green" Policy (USEPA, 2009b) and Region 9's Cleanup-Clean Air Initiative (USEPA, n.d.1).

Green remediation strategies take precaution to protect areas that surround contaminated sites and help ensure environmental, human health, and economic benefits to those areas. Construction and operation activities associated with the cleanup of private and federal hazardous waste sites are often sources of GHG and other air pollutants. Many treatment technologies, such as ground water pump and treat systems, use energy from fossil fuel powered utilities for many years and in some cases decades. Heavy equipment used during site remediation is usually powered by diesel engines, which emit a complex mixture of air pollutants including both solid and gaseous materials that have serious human and environmental impacts. Diesel emissions pose particular concern in non-attainment areas and additional problems in environmental justice communities that face disproportionate burdens of potential exposure to environmental hazards. Opportunities to reduce these impacts exist through innovative approaches, treatment system optimization, and use of more sustainable practices and technologies such as renewable energy sources, more efficient treatment equipment, and clean diesel technologies.

Green remediation also provides a useful perspective for considering other issues, such as materials and resources used in the remediation process, potential impacts on land and water resources and ecosystems, and ultimate reuse and stewardship of a site. Green remediation involves understanding and addressing the effects of selected response actions, from the early assessment phases through remedy selection and implementation to long-term operation, maintenance, and project closeout. Green remediation provides a basis for ensuring that remedies are designed and operated in a manner that not only minimizes negative impacts on the environment but also may result in cost savings.

The Agency's *2006-2011 Strategic Plan* includes a number of goals and objectives that can be advanced by green remediation. Goal 5 ("Compliance and Environmental Stewardship") of the Strategic Plan specifies that stewards of the environment recycle wastes to the greatest extent possible, minimize or eliminate pollution at its source, conserve natural resources, and use energy efficiently to prevent harm to the environment or human health (USEPA, 2006). Under sub-objective 3.2.2 ("Clean Up and Revitalize Contaminated Land"), the Agency commits to ensuring that substantial numbers of NPL sites are ready for site-wide reuse.

1.3 Green Remediation and Other Waste Programs

Promoting clean energy and mitigating climate change are top priorities for EPA. Superfund's green remediation efforts are intended to intersect a variety of initiatives in other waste programs across EPA, states, and other federal agencies that are addressing sustainability and climate change issues. OSWER also is working to maximize community benefits of the various waste programs, including site remediation under Superfund.

OSRTI is working with other OSWER cleanup offices to ensure consistency in green remediation concepts and implementation approaches. This Strategy was developed primarily with the Superfund Remedial Program in mind, and other Agency cleanup programs are anticipated to find information and recommendations in the Strategy to be useful. Other federal and state cleanup programs also may adopt some of the implementation steps and evaluation activities to address sustainability and climate change issues. Implementation of the Strategy will involve a dynamic interchange of ideas, data, and practices within and outside of the Superfund Remedial Program. The Agency also expects to exchange "lessons learned" with our partners in cleanup as efforts evolve over time.

1.4 Incorporating Green Remediation into Site Sustainability

Green remediation strategies help reduce the environmental footprint of cleanup activities. Greater site sustainability can be achieved by incorporating greener approaches and practices in all phases of a cleanup and redevelopment project. An integrated approach can include:

- Deconstructing a site's buildings and infrastructure and reusing the materials on site;
- Designing cleanups such that mixed use and smart-growth land reuse opportunities can be maximized;
- Employing green building design and construction practices; and
- Planning long-term remedy operations and reuse activities that are less environmentally intensive and pose minimal adverse impacts (such as diesel emissions and fugitive dust) on local communities.

Encouraging an overall "green" view of project life cycles will help ensure that green remediation techniques and redevelopment practices are incorporated and become opportunities for meeting long-term health, environmental, social, and economic goals within a community.

1.5 Federal and State Statutes and Executive Orders Promoting Energy and Water Conservation

Green remediation strategies involve concepts of numerous executive orders and federal or state statutes and regulations that specifically address reductions in energy and water consumption, increased use of renewable energy, and conservation of other natural resources. In particular, the Energy Policy Act of 2005 promotes energy conservation nationwide. The Energy Independence and Security Act of 2007 builds on the Energy Policy Act by setting additional goals for energy consumption and associated GHG emissions, including increased use of alternative fuels for vehicles and accelerated research and development of alternative energy resources. Executive Order (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, builds on these mandates, stating that it is the policy of the United States that federal agencies conduct their environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically, and fiscally sound, integrated, continuously improving, efficient, and sustainable manner (EO, 2007).

Beyond federal efforts, many states are adopting climate legislation and policies, creating climate action plans, and providing incentives to create renewable energy projects.[4] A majority of states and the District of Columbia have implemented policies for renewable portfolio standards that require electricity providers to obtain a minimum percentage of their power from renewable energy resources by a certain date.

[4] See information on state energy policies and incentives in: *Database of State Incentives for Renewables & Efficiency* (North Carolina Solar Center/Interstate Renewable Energy Council, n.d.) and *U.S. States & Regions* (Pew Center on Global Climate Change, n.d.).

2.0 Superfund Remedial Program's Green Remediation Goals and Key Action Items

The NCP is the blueprint for Superfund cleanups. It addresses response actions for oil spills as well as hazardous substances, pollutants, and contaminants. Under CERCLA and the NCP, remedial response actions may involve a number of steps including site assessment, remedial investigation, feasibility study, remedy selection, remedy implementation, and a five-year review for a site where waste is left on site. Employing green remediation practices fits within the statutory and regulatory framework of the Superfund Remedial Program.

Green remediation comprises a range of best practices that can be applied throughout the Superfund cleanup process, beginning with site assessment and investigation and extending through remedy operations. The practices provide means to improve waste management; conserve or preserve energy, fuel, water, and other natural resources; reduce GHG emissions; promote sustainable long-term stewardship; and reduce adverse impacts on local communities during and after remediation activities. Green remediation can also complement efforts to return brownfields and private or federal Superfund sites to productive use in a sustainable manner, such as utility-scale production of renewable energy.

Green remediation activities are within the scope of a Superfund response and can help ensure a protective remedy. For sites where the remedy has already been selected, it often will be possible to implement the remedy in a way that is more sustainable and has lesser long-term negative effects on the environment. At sites with operating remedies, green remediation practices can be used to upgrade or optimize treatment systems.

Green remediation options should be evaluated under CERCLA requirements and relevant NCP provisions as a means to help ensure protectiveness of human health and the environment. Since the enactment of CERCLA and promulgation of the NCP, EPA has undertaken various initiatives that may provide a platform for consideration and implementation of green remediation, such as the Ground Water Optimization Initiative[5] and the Superfund Redevelopment Initiative (SRI).[6]

Green remediation is viewed as a means to enhance remedy protectiveness, not as a disincentive to active remediation processes or an approach that reduces remedy protectiveness.

In addition, the Environmentally Responsible Redevelopment and Reuse (ER3) Initiative[7] encourages developers and property owners to implement sustainable practices during redevelopment of contaminated sites. The ER3 Initiative complements EPA's efforts to clean up

[5] OSWER initiated optimization of Superfund-financed ground water remedies as part of the *FY2000-FY2001 Superfund Reforms Strategy* (OSWER 9200.0-33; July 7, 2000). Remedy optimization is designed to facilitate systematic review and modification of remedies to promote continuous improvement and enhance overall remedy and cost effectiveness (USEPA, n.d.8). In the Superfund Program, optimization evaluations generally use the remediation system evaluation (RSE) process, a tool developed by the U.S. Army Corps of Engineers. RSEs can be conducted for Superfund remedies involving one or more technologies used for ground water, soil, and/or sediment treatment (USEPA, n.d.2).

[6] The SRI Initiative helps communities return some of the nation's worst hazardous waste sites to safe and productive uses. In addition to cleaning up Superfund sites and making them protective of human health and the environment, EPA is working with communities and other partners by considering reasonably anticipated future land use in the cleanup process. The Agency also is working with PRPs and communities at sites that have already been cleaned up to ensure that long-term stewardship of cleanups will support anticipated reuse (USEPA, n.d.7).

[7] EPA's ER3 Initiative uses enforcement incentives to encourage developers, property owners, and other parties to implement sustainable practices during cleanup, redevelopment, and reuse of contaminated sites (USEPA, n.d.3).

contaminated sites. Through OSRE's partnership with OSRTI, the ER3 Initiative also includes green remediation as part of its efforts to promote sustainable cleanup of contaminated sites.

In addition to general green remediation steps that parties can take throughout the cleanup life cycle, such as minimizing travel to and from sites, decision makers can integrate relevant practices of green remediation into all phases of the remedial process:

- **Preliminary Assessment and Site Investigation (PA/SI):** Project managers should consider more efficient, streamlined approaches that minimize field mobilizations, materials and natural resource consumption, and waste generation during a preliminary assessment and site investigation.
- **Remedial Investigation and Feasibility Study (RI/FS):** More intensive site characterization activities including sampling can benefit by employing the same practices mentioned above. In addition, when developing options for remedial actions that are consistent with remedial action objectives, project managers should consider alternatives that include opportunities for reducing the environmental footprint of remedial design and construction activities.
- **Remedial Design (RD):** Opportunities to integrate green remediation strategies into a remedy can be taken when:
  - Designing a new remedy, or
  - Updating an existing remedy to ensure remedy protectiveness, based on new information or changes in science and technology.
- **Remedial Action (RA):** The construction phase as well as the operational phase of a remedial action provides significant opportunities to reduce onsite and offsite footprints of a cleanup. Best practices introduced during construction can continue during remedy operation; practices include using clean fuels and renewable energy sources for vehicles and equipment, substituting diesel trucks with railroads for material and waste transport, retrofitting diesel machinery and vehicles for improved emission controls, reusing construction and routine operational materials, reclaiming demolition or processing waste, and installing maximum controls for stormwater runoff.
- **Short- and Long-Term Remedy Operations and Five-Year Reviews:** Periodic reviews are required at sites where contaminants remaining on site after a cleanup action do not allow for unrestricted use or unlimited exposure. The five-year review serves to ensure that the remedy remains protective and offers opportunities for project managers to consider whether green remediation practices can be integrated into remedy operation and maintenance.

EPA considers reasonably anticipated future land use throughout the remedy selection and implementation process to help ensure that response actions will remain protective in light of the anticipated reuse of remediated sites. Green remediation strategies can complement anticipated site reuse involving sustainable activities or property development in accordance with community-level smart growth principles and green building practices. Integrated planning of cleanup and reuse projects also facilitates sharing of site infrastructure components such as stormwater controls, waste recycling networks, or small-scale renewable energy systems.

The following sections describe the key actions that have been identified to implement green remediation practices in the Superfund Remedial Program. At the end of each action item, the phrase "under development," "to be initiated," or "already implemented" is included to inform readers of the progress to date at implementing the action item.

2.1 Policy and Guidance Development

Goal:

Provide policy and guidance to achieve greater consideration and use of green remediation practices throughout the Superfund remedial cleanup process (consistent with CERCLA and NCP requirements) that will provide a clear, legally defensible foundation for facilitating green remediation.

Introduction:

Key actions in this section are intended to integrate green remediation within the Program and provide an overall context for green remediation to be used to the maximum extent practicable. As such, a policy statement should be developed to clarify what green remediation is within the sphere of Superfund remedial activities and how it fits within the various phases of the Program, and to encourage EPA regions and others to work collaboratively to effectively implement Superfund cleanups in as sustainable a manner as practicable.

The action items in this section are intended to integrate green remediation concepts into Superfund response actions that are consistent with the Statute and the implementing regulations. EPA regions may wish to adapt or tailor the action items and concepts for incorporation into region-specific policies. As the national framework for green remediation evolves, these key action items may need to be revised.

Key Action #1: Clarify the role of green remediation in remedy selection and implementation

The goals of green remediation are consistent with objectives and processes specified in CERCLA and the NCP. The NCP provides detailed expectations and criteria to follow in selecting and implementing cleanup remedies. This action area describes efforts that would be undertaken to ensure that green remediation efforts can be effectively considered and integrated into Superfund response actions, while adhering to NCP requirements and requirements of other related statutes. The following actions will be taken:

1.1 Develop a Superfund Remedial Program white paper on green remediation: Prepare a white paper to: (a) examine how green remediation may be considered within the existing CERCLA and NCP framework for response actions, and (b) evaluate ways to integrate green remediation throughout response actions and within technical assistance contracts as well as assistance agreements and interagency agreements (IAs). [*under development*]

1.2 Develop OSWER policy on green remediation in remedy selection for remedial and non-time critical removal actions: OSRTI is working with FFRRO and other OSWER offices (the Office of Brownfields and Land Revitalization, Office of Underground Storage Tanks, Office of Resource Conservation and Recovery, and Center for Policy Analysis) and other Agency offices to develop a consistent green remediation approach. This policy will address how to evaluate green remediation and sustainable activity in the context of the Superfund Program. It would likely clarify how green remediation can be factored into the nine evaluation criteria and the evaluation criteria for non-time critical removal actions (involving the EE/CA process) within the overall remedy selection framework. Any policy recommendations would address the importance of key statutory requirements and NCP provisions. [*under development*]

1.3 **Evaluate potentially applicable or relevant and appropriate requirements (ARARs):** Analyze and summarize existing state and federal regulations and policies that may pertain to green remediation (such as state renewable energy portfolio standards) to determine their potential to serve as site-specific ARARs under CERCLA. This analysis could assist regions in developing and implementing remedies that address new ARARs while meeting goals of green remediation. Summary information would be distributed to EPA regions and posted on OSRTI's cross-program "Green Remediation" page of the "CLU-IN" Web platform.[8] [*to be initiated*]

2.2 Resource Development and Program Implementation

Goal:

Develop a compendium of green remediation practices and resources to help on-scene coordinators (OSCs) and remedial project managers (RPMs) ensure that green remediation is considered throughout the response process and in meeting remedial goals.

Introduction:

Throughout the Superfund cleanup process (including site assessment and characterization, removal, design, construction, operation and maintenance, monitoring, closeout, and revitalization), there are opportunities to increase the total benefit of a cleanup and contribute to site sustainability. As cleanup technologies continue to advance and related options evolve, green remediation strategies may offer significant potential for reducing project costs while meeting the selected remedy's remedial action objectives. The goal of these key actions is to research and evaluate existing or evolving green remediation resources such as technical information, new technologies, internal and external knowledge, funding, contracts, and grants, and to develop new tools and resources, as needed.

Key Action #2: Develop a compendium of practices and tools to help project and Program managers integrate green remediation practices

The compendium would be designed to facilitate understanding and implementation of green remediation efforts by consolidating available tools and resources in a central location to be organized by cleanup phase (i.e., site discovery through post-construction). Quality assurance/quality control procedures would be established to minimize duplicative/excessive information, ensure efficiencies, and provide user-friendly navigation.

Updates to the tools and compendium will be developed as needed to reflect evolving cleanup or auxiliary technologies and new practices. The following are some of the expected actions to be taken when developing the compendium:

2.1 **Identify green remediation resource needs:** Research and evaluate existing green remediation tools and frameworks available on CLU-IN as well as materials such as checklists, fact sheets, and outlines issued by regional or other program offices, to identify resource needs. [*under development*]

2.2 **Identify additional green remediation information resources:** Reach out to communities, contractors, technology vendors, states, other EPA workgroups, and non-governmental organizations for green remediation evaluations, case studies, fact

[8] Cross-program technical materials, federal and state policies, and background information are available on the *Green Remediation* Web site at: http://CLU-IN.org/greenremediation (USEPA, n.d.4).

sheets, etc. Engage and partner with other federal agencies to document and share tools and best practices. [*under development*]

2.3 Develop a Superfund Remedial Program framework outlining key concepts in green remediation: Draft the framework and circulate the product throughout OSRTI, OSRE, other OSWER program offices, and the regions for review and comment. After revising, share the framework with other Superfund stakeholders for review and comment. Finalize this framework to provide a clear, unified overview of the components of green remediation. [*under development*]

2.4 Develop technology-specific assessment tools and fact sheets: Continue developing fact sheets that demonstrate best management practices of green remediation.[9] Fact sheets will address specific technologies as well as particular remedies or crosscutting topics. One example is a fact sheet illustrating site-specific application, unique considerations, and operating procedures associated with green remediation practices in pump and treat remedies. Evaluate and provide tools that help assess the environmental footprint of specific technologies. Examples of tool topics include conducting life cycle assessment of remedial actions, information on the use of liquid fuels during site operations, and evaluation of energy and water consumption and GHG emissions. [*under development*]

2.5 Develop green remediation "Q&A's": Develop "Questions & Answers" and "Myths vs. Facts" summaries to foster better understanding of green remediation. Topics may include the methodologies for evaluating potential remedy implementation strategies (as described under Key Action #8) and assessing public health enhancements resulting from use of green remediation strategies. [*to be initiated*]

2.6 Produce green remediation checklists: Develop checklists for existing Superfund processes (PA/SI, RI/FS, and RD/RA) and long-term response actions. Checklists would include the Agency's Remedy Update Reform RSEs and five-year reviews, which can be used to foster recommendations for green remediation practices that take advantage of advances in science and technology. Headquarters will work with existing checklists developed through regional or cross-program initiatives to the extent possible (e.g., Region 2's "Green Site Assessments and Remediation Checklist for the Superfund RI/FS," Region 3's green cleanup standards and certification efforts (USEPA, 2009c), and the Engineering Forum's checklist for energy conservation and production (USEPA, 2004)) and issue national checklists. [*under development*]

2.7 Develop an on-line application and an electronic notebook encompassing the compendium for use by RPMs/OSCs and others to search the latest green remediation tools, incentives, and other information: The electronic notebook will serve as an automated, quick-reference guide and a resource for in-depth research. It will be organized and cross-referenced to help identify green options according to cleanup phase, find information on a particular technology's performance, and obtain additional assistance. [*to be initiated*]

2.8 Establish a green remediation page on the Agency's Superfund Web site: Add a "Superfund & Green Remediation" page to OSRTI's Superfund Web site in order to increase awareness about green remediation specific to the Superfund Program, and update the page with future products developed under this Strategy.[10] [*already implemented*]

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[9] Such as: *Green Remediation: Best Management Practices for Excavation and Surface Restoration* (USEPA, 2008b).
[10] See *Superfund & Green Remediation* at: http://www.epa.gov/superfund/greenremediation (USEPA, n.d.6).

2.9 Deliver or host green remediation training through the Technology Innovation and Field Services Division's training infrastructure: Training generally will be co-located with other venues such as annual National Association of Remedial Project Managers (NARPM) conferences, OSC Readiness training, and North American Commission for Environmental Cooperation meetings. Internet seminars on CLU-IN also will be held periodically. [*already implemented*]

2.10 Provide site-specific assistance and assistance mechanisms: Headquarters will assist regional staff in reviewing green remediation options during the investigation and selection process and in optimizing and retrofitting existing systems. This assistance includes direct technical support from experts in Agency program offices and groups such as the Technical Support Project's Green Remediation Committee. OSWER also could collaborate with the Office of Research and Development's National Risk Management Research Laboratory (NRMRL) through: (a) NRMRL's Materials Management and Remediation Center operating under the Environmental Technology Verification Program, and (b) workings of the Superfund technical liaisons. Site-specific assistance mechanisms would include OSWER IAs with missions to support green remediation. [*already implemented*]

Key Action #3: Identify options that enable use of green remediation practices

The Superfund Remedial Program needs to examine whether additional options are needed to incorporate green remediation consistent with the NCP. Such options may be designed to complement activities developed independently by EPA regions, other agencies, states, and local communities. Potential actions include:

3.1 Develop a better understanding of the costs or savings associated with use of green remediation strategies and practices: Evaluate the costs and savings of various green remediation strategies, including greater energy efficiency, by analyzing the data available at a sample of green remediation projects implemented to date. The Agency will evaluate and build upon successful internal and external efforts to facilitate green remediation. EPA anticipates working with other federal agencies, states, and private industry to find independent mechanisms that may include loans or grants, expedited permitting processes used by state or local government agencies, cleanup contractor bonuses, a green cleanup certification system, and/or renewable energy certificates (RECs). Findings will be summarized and made available to the public through online CLU-IN seminars and documents posted on OSRTI's green remediation Web pages. [*under development*]

3.2 Identify opportunities to finance green remediation practices consistent with the NCP at Fund-lead sites: These options may include establishment of headquarters and/or regional green remediation funds that can be used to finance green remediation activities. The Agency would need to establish the amount of available funding, criteria for accessing the fund, and methods for returning any savings to the fund and/or the region. Related lessons and strategies gained at Fund-lead sites may then be applied to similar efforts at federal facility, state-lead, and PRP-lead sites. [*under development*]

3.3 Analyze issues involved in use of RECs: Options will be examined for purchasing RECs at sites without onsite or directly accessible renewable energy sources. Derived REC attributes such as avoided emissions, eligibility for emission reduction credits or offsets, and price stability will be integrated into green remediation site-specific and program evaluations. [*to be initiated*]

3.4 Explore and/or establish mechanisms to finance green remediation research, development, and demonstration (RD&D) and initial deployment at Superfund sites: OSRTI and FFRRO should identify existing federal resources (such as U.S. Department of Defense, U.S. Department of Energy (DOE), and Small Business Innovation Research programs) to support green remediation research and application. One sample approach for this action is the Materials Management and Remediation pilot project sponsored by the public-private Environmental Technology Verification Program. Finance mechanisms would include use of assistance agreements, IAs, and contracts as appropriate (see Key Action #6). [*under development*]

3.5 Identify a Superfund green remediation liaison/coordinator in each region: This position is similar to the brownfields coordinator and the Superfund redevelopment coordinator. Each liaison/coordinator will foster consideration of green remediation within his/her region, serve as a liaison in green remediation issues, coordinate with other regional programs, and update stakeholders on potential or actual changes in environmental and community impacts as a result of using green remediation strategies. [*already implemented*]

3.6 Participate in development of a national standards and certification process: Superfund will build on Region 3's current project involving EPA participation in an ASTM International task to develop a national, voluntary standard for green cleanups.[11] The Agency is working with state partners to develop a draft framework that outlines desired outcomes for a green cleanup standard and serves as a starting point for the consensus-based process used to develop the standard. In 2009, the Agency's Green Cleanup Standards Workgroup will continue developing various options for associated certification of voluntary green cleanups. [*under development*]

Key Action #4: Address air pollutants and diesel emissions

This key action incorporates the use of diesel emission reduction practices and clean diesel technologies into response programs in a manner consistent with CERCLA and the NCP and while reflecting national priorities and tradeoffs. Use of clean diesel technologies would be explored for all contract types, regardless of the cleanup leads involved.

Diesel emissions pose significant risks to people -- residents and workers alike -- and should therefore be minimized.

4.1 Develop an OSWER/OSRTI fact sheet (in coordination with the Office of Air and Radiation and EPA regions) on clean diesel technologies: The fact sheet would discuss existing documentation that shows how using clean diesel equipment reduces emission of nitrogen oxides, particulate matter, and air toxics, which contribute to serious public health problems and adversely affect air quality. The fact sheet would target ways to minimize total emissions, covering topics such as operational practices (e.g., proper service and maintenance procedures and engine idle reduction plans), use of advanced technology (e.g., retrofitting machinery for diesel engine emission control and exhaust treatment technologies such as particulate filters and oxidation catalysts), and the influence of factors such as equipment type or age. The fact sheet also will foster a better understanding of the environmental sustainability of various liquid fuels such as biodiesel. Information resources would include technical material such as EPA's *Smart Energy Resources Guide* (USEPA, 2008e). [*to be initiated*]

[11] See periodic updates on EPA's Green Cleanup Standard Initiative (USEPA, 2009c) and related updates from ASTM International (ASTM International, n.d.).

4.2 Develop cleanup contract requirements for incorporating clean diesel technologies and fuels: Sample contract language developed under Key Action #6 would include considerations or requirements regarding air emissions. [*under development*]

Key Action #5: Develop pilot projects to evaluate and demonstrate green remediation applications

Pilot projects will help the Program build a collection of data on actual costs and results of green remediation approaches, operational and administrative lessons learned, and materials for planned trainings and information sessions. Headquarters could provide regions with funding to support scoping, planning, or design activities related to green remediation projects.

5.1 Encourage regions and headquarters to undertake innovative green remediation pilot projects: OSRTI and FFRRO would request that each region identify one or more pilot projects. The pilots would develop information based on practical field experience with green approaches. OSRTI's Technology Innovation and Field Services Division and the regions will collect data generated from pilot projects and develop a comprehensive database supporting future actions. [*under development*]

5.2 Develop and pilot test a green remediation analysis template that will help collect information during various phases of the remediation process at any site: The template could consist of a series of checklists for compiling baseline information and comparing potential green strategies. Template topics will include opportunities for greater energy efficiency and site suitability for long-term wind farming, solar or thermal energy generation, and gas production. [*under development*]

5.3 Launch a pilot project incorporating green remediation considerations into all remedy optimization evaluations and assessing the feasibility for all optimizations by FY 2010: The pilot will include consideration of energy efficiency and alternative energy sources, reduction of air emissions, reduction of waste generated by the remedy, minimizing habitat destruction, and other key green remediation considerations relevant to the operating remedies. Experience gained during the pilot may result in a revised optimization process to account for potential components of green remediation. [*already implemented*]

5.4 Support the RE-Powering America's Land Initiative by identifying Superfund sites with outstanding or superb renewable energy potential:[12] Regions will be encouraged to work with renewable energy developers and other stakeholders to assess feasibility of locating renewable energy generation projects on contaminated lands and mining sites. Technical assistance to the regions is available through an OSWER IA with DOE's National Renewable Energy Laboratory. [*under development*]

Key Action #6: Establish opportunities in contracts and assistance agreements to identify green remediation practices in selected remedies

Opportunities to modify existing and upcoming contracts, cooperative agreements, grants, and IAs will be assessed as a means to identify green remediation best management practices consistent with the remedy selected. Consistent with Federal Acquisition Regulations and

[12] RE-Powering America's Land products include maps and incentive sheets on potential for community wind energy, utility-scale wind energy, concentrating solar power, photovoltaic solar energy, and biomass energy (USEPA, n.d.5).

Executive Order 13423 (EO, 2007), OSWER will work with the Office of Acquisitions Management to explore the following:

6.1 Modify contract language to identify green remediation practices consistent with remedy selection under the NCP: Identify upcoming solicitations and develop language for the statements of work (SOWs) and requests for proposals. Modify SOW language in existing remedial and removal contracts (both region-wide and site-specific) and work assignments or task orders whenever possible. New and modified contracts can include results-based language directing contractors to explore green strategies (e.g. reducing energy and fuel usage, incorporating renewable energy sources, and increasing material reuse) in all cases with the exception of time critical removals. Use regional Remedial Action Contract (RAC) and Emergency and Rapid Response Services (ERRS) SOWs (such as those developed in Regions 2, 9, and 10) to develop national model contract language with SOWs that reference Executive Order 13423 or other mandates. Inclusion of specifications outlined in Federal Acquisition Regulations may be considered. [*under development*]

6.2 Modify contract language to require reporting of selected activities: Modify SOW language in corresponding remedial and removal contracts (and/or associated work assignments or task orders) to require contractors to annually and/or monthly report on headquarters or regional concerns such as energy and fuel usage, separate from other direct costs. [*under development*]

6.3 Develop and periodically update a green remediation contracting tool kit: Disseminate the *Green Response Action Contracting and Administrative Toolkit* issued in June 2009 to regional project managers and Superfund contractors (USEPA, 2009e). Continue compiling new language adopted by regions or other agencies and information on innovative contracting or administrative mechanisms coming into use, and make toolkit updates publically available through posting on OSRTI's green remediation Web pages. [*already implemented*]

6.4 Develop model terms and conditions for assistance agreements and IAs concerning site cleanup: Using regional examples such as Region 2's IA with the U.S. Army Corps of Engineers, draft and institutionalize requirements for green remediation considerations consistent with the selected remedy in non-contracting vehicles such as assistance agreements and IAs. Develop model outputs/outcomes for regions to use in state agreements. [*under development*]

6.5 Explore additional opportunities to use existing federal agreements and establish new agreements: Use OSWER's memoranda of understanding and/or IAs with the National Renewable Energy Laboratory and Argonne National Laboratory to provide regions with site-specific technical assistance. Pursue additional IAs with other agencies to further enable green remediation consistent with NCP response actions. [*under development*]

6.6 Explore and promote opportunities to use local expertise in green cleanups: OSRTI will work with regional community involvement coordinators to engage stakeholders in worker training and hiring opportunities applicable to green cleanups. For example, regional and local utility businesses will be encouraged to develop strategies that develop and retain local workers with expertise in energy optimization and renewable energy integration. In addition, local government agencies and businesses directly or indirectly involved in cleanups will be encouraged to institutionalize service contracts and agreements with clauses that give preference to local workers and firms using environmentally preferable practices. [*to be initiated*]

Key Action #7: Communicate and share success stories and lessons learned among "implementers" across the Program and the public

Development of green remediation program-wide and site-level initiatives will depend on shared activities and information that involve multiple interested parties, disciplines, and federal and state cleanup programs. A dedicated, well organized communications effort would be needed to: (a) ensure that all stakeholders have an opportunity to be involved, (b) ensure consistency of green remediation messages across and within programs, (c) share technical and programmatic information, and (d) provide options that incorporate green remediation practices. The following initiatives are expected to address these needs:

7.1 Develop a communication plan: The communication plan will complement OSWER efforts to ensure consistency of green remediation messages across the various cleanup programs. Success stories and lessons learned will be shared with communities, EPA regions, other federal agencies, states, local organizations, and contractors through use of tools such as Web sites, regular conference calls with regional staff and managers, webinars, and the electronic notebook. Regular communications at events such as OSC Readiness and the annual NARPM training conference are an integral aspect of the plan. Communications also will be maintained at non-Superfund events such as the National Brownfields Conference, the RCRA Corrective Action Conference, and the National UST Conference. [*under development*]

7.2 Conduct outreach to contractors and industry: This outreach will facilitate information sharing among EPA regions and help define or refine the best management practices of green remediation. Target information includes success stories, complications and technical roadblocks, and costs incurred or saved. [*under development*]

7.3 Partner with other federal agencies and state organizations to promote national use of green remediation strategies: Documents prepared by EPA should be shared with other agencies and state organizations for use by their members. Government organizations with work teams dedicated to green cleanup issues include the Federal Remediation Technologies Roundtable, Interstate Technology and Regulatory Council (ITRC), and Association of State and Territorial Solid Waste Management Officials (ASTSWMO). OSRTI and FFRRO will partner with other federal agencies and states to compile federal and state publications and information resources on green remediation and distribute them to EPA, state, and other federal agency program and project managers. [*already implemented*]

7.4 Engage local communities in assessing and implementing green remediation options: OSRTI will work with regions to enhance participation of local stakeholders, including minority and low-income populations affected by site cleanup. Mechanisms may include the Technical Outreach Services for Communities Program to help communities understand technical issues and opportunities posed by green remediation options; the Technical Assistance Grant Program to establish information networks; and the Superfund Job Training Initiative to help educate local workers in specialty fields such as energy efficiency and renewable energy applications. [*to be initiated*]

7.5 Develop a series of green remediation "citizen's guides:" Develop several citizen's guides that explore specific green remediation approaches and options and encourage meaningful participation in remedy selection and remedy design processes. [*to be initiated*]

2.3 Program Evaluation

Goal:

Identify and make available measures and metrics for evaluating green remediation implementation at a site level and a Program level as part of a coordinated effort among OSWER program offices. The resulting measures and metrics can be used to integrate green remediation goals in the EPA's Strategic Plan and align with Agency budgets.

Introduction:

Evaluation objectives for green remediation are needed at both the site and Program levels to: (1) identify elements to be measured, (2) evaluate progress resulting from green remediation practices over time, and (3) report accomplishments at specific sites and within the Program.

In order to frame the evaluation measures to be developed, OSWER will need to establish criteria for selecting the measures. Criteria can include considerations such as the degree of resolution acceptable for different parameters; limits to the level of effort required to implement the measures; the need to align with EPA goals; and the needs of various users such as site managers, regional offices, and national program managers. The criteria should also address acceptable approaches and scope for addressing indirect or intangible effects of green remediation, including how to ensure that local governments and communities weigh disparate measures such as cost, emissions, energy use, impacts on local ecosystems, and effects on communities.

Initially, EPA can establish internal baseline estimates on specific parameters (such as energy use, fuel consumption, air emissions, and water use) as well as use of the best practices. Examples of baseline parameters include the extent to which decision makers consider green options, adopt green approaches, or use best practices as an integral part of the Superfund process. Clearly defined measures and metrics will expedite subsequent data collection as well as contribute to the use of qualitative measures for reporting progress on attaining green remediation goals while remaining within Agency budgets. EPA will work with states through ASTSWMO and the ITRC to identify measures and metrics that also can be specified in assistance agreements and IAs concerning green remediation.

Internal baselines will provide the Agency with a starting point from which to measure related changes and quantify related project improvements in accordance with one or more core elements of green remediation.

This key action will begin by examining existing tools developed by Agency program offices, other federal agencies, states, and private industry for potential application to the program. Common needs in site and Program evaluations include:

- **Performance measure benchmarks,** which will build upon Agency and other standards such as ASTM International's environmental management series or a forthcoming green cleanup standard, as well as policies and methodologies issued under initiatives such as the United Nations Framework on Climate Change (United Nations, 2003). Baselines and methodologies pertaining to GHG and associated consumption of fossil fuel energy will be derived in part from EPA information such as the Office of Air and Radiation's April 10, 2009, proposed rulemaking on reporting of greenhouse gases (USEPA, 2009a) and EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2007* (USEPA, 2008d).
- **Evaluation measures,** which must be meaningful and transferable across site and Program use levels. Anticipated measures include fuel and energy consumption,

contributions from renewable energy sources, GHG and air contaminant emissions, water consumption and reuse, and material recycling or reuse.

- **A core set of metrics** that is practical to apply and poses minimal reporting burdens on RPMs and OSC**s.** Consistent, intuitive metrics will help balance project decision making and supply quantitative or qualitative data for measuring changes from green remediation baselines. Examples include gallons of fuel, kilowatts of electricity, pounds of carbon dioxide equivalents, gallons of water, and cubic yards of waste.

Key Action #8: Evaluate green remediation application at the site level

In order to make informed decisions on green remediation practices at a site level, a consistent approach is needed to quantify cleanup footprints associated with each of the core elements of green remediation on a site-by-site basis. Many tools exist for evaluating the effects of site activity on one or more core elements, but none meets the Agency's need to evaluate all core elements affecting site cleanup. Information gathered from the Program's pilot projects will generate useful data and lessons to be used in developing a consistent "roadmap" for site-specific evaluation of green strategies. The green remediation roadmap will maintain consistency with NCP criteria for remedy evaluation.

RPMs and OSCs can use the roadmap to collect and evaluate information at a site-specific level, enabling them to focus efforts on reducing potential footprints through innovation, optimization, and best practices. The roadmap could be applied during remedy selection, design, construction, operation, and monitoring phases. In all cases, consideration of the environmental footprint of remedy alternatives assumes that each adequately addresses a site's remedial objectives. Collective information gathered under this key action can also contribute to Program evaluation efforts by Agency management (Key Action #9). Specific actions may involve:

8.1 Compile and analyze existing tools with measures and metrics for evaluating sustainability: Existing tools for addressing one or more core elements will be researched and summarized in terms of scope that aligns with the core elements and applicability to site cleanup. Resulting information will be summarized in a comprehensive document made available to RPMs, OSCs, and other stakeholders, and frequently updated to reflect new or expanded tools (USEPA, 2009d). [*already implemented*]

8.2 Develop criteria for selecting site-specific evaluation measures and metrics: Results of EPA green remediation pilot projects, the existing tools for general evaluation of core elements, and applicable portions of cleanup evaluation tools developed by other agencies or private industry will be analyzed. The analysis will be used to describe and document tangible/intangible, unique, and composite measures of value to decision makers as well as specific criteria for use in choosing suitable measures and metrics at a particular site. [*under development*]

8.3 Develop modules for core element evaluation: Methodologies for selecting and applying suitable measures and metrics will be developed for each core element of green remediation. Each module will delineate an approach for identifying and prioritizing constituents of a footprint, estimating a footprint made by a potential or existing remedy, and identifying best practices or innovative solutions to reduce the footprint. [*under development*]

8.4 Recommend methods for determining total benefit of a cleanup: Existing guidance and tools will be analyzed to identify methodologies for evaluating and weighing factors

that can estimate: (a) the benefits of incorporating green remediation practices at a site, and (b) associated total benefit of a cleanup. The Program will compile a limited array of potential resources and recommend selected methodologies pertaining to sample cleanup scenarios. [*to be initiated*]

Key Action #9: Develop Program evaluation measures

Program management at a regional or national level needs consistent quantitative and qualitative tools to evaluate program direction. Program evaluations will aggregate the parameters used in site-level assessments, such as GHG emissions and water and energy use. Efforts can build on preliminary studies such as OSRTI's estimates regarding energy consumption and carbon dioxide emissions from frequently used treatment technologies at NPL sites (USEPA, 2008a). The following efforts would lead to development of a core set of evaluation objectives that may be applied across the Program and provide information for EPA's Strategic Plan.

9.1 Develop options for addressing possible gaps in measures or metrics: This activity will examine and identify gaps in measures and metrics identified through site-specific green remediation evaluations or in other strategic activities. Gaps may relate to environmental outcomes that are difficult to quantify in terms of cleanup baselines, such as changes in sulfur dioxide and nitrogen oxide emissions, while other gaps may relate to complex issues such as carbon sequestration. Options for resolving measures and metrics gaps may involve application of methods such as present value analysis. [*to be initiated*]

9.2 Characterize the state of practice and implications of life cycle analysis and net carbon footprint analysis on Program operations: Identify and develop tools and guidance to explore: (a) upstream and downstream impacts on the environmental footprints of remedial actions, (b) methods for aggregating data on disparate metrics to inform program-level issues, and (c) approaches for comparing options extending over different time periods (e.g., excavation and disposal versus multi-year, onsite treatment). Upstream impacts may include offsite activities such as material manufacturing that consumes energy and water. Potential downstream contributors include activities such as discharge of wastewater to publicly owned treatment works. Impact characterization would help direct environmental implications of the Program's actions over time. [*under development*]

9.3 Coordinate recommended Program performance measures with activities supporting green remediation resource development and program implementation (Actions 2.1 through 7.5): The core set of programmatic measures should align with strategic Program products such as the green remediation compendium and pilot projects. This coordination would ensure that recommended measures are feasible and practical and that they may be appropriate for use in developing and evaluating Program objectives. [*under development*]

> Region 2 intends to measure the cost differentials and environmental benefits associated with implementing its *Clean and Green* policy. Examples include tracking quantities of materials reduced, reused or recycled; carbon or greenhouse gas reductions; and quantities of water conserved or replenished. The Region plans to use existing progress reporting requirements in enforcement instruments, grants, and contracts to collect this data.
>
> *Region 2 "Clean and Green" Policy*

3.0 Implementation of the Superfund Green Remediation Strategy

One of the major challenges in implementing this Strategy is developing a baseline of information on cleanups using traditional approaches. A baseline is essential for identifying the greatest opportunities for improving environmental outcomes of cleanups, evaluating the effects of Strategy implementation, and determining appropriate Program goals.

Key Action #10: Evaluate the Superfund Green Remediation Strategy

This key action involves a formative evaluation of the new approaches related to usage of energy, water, and other natural resources. Results also may be used to address cross-program priorities.

10.1 Estimate environmental outcomes of traditional cleanups: This information would be used to determine the current baseline of energy, fuel, and water usage at Fund-lead sites prior to Strategy implementation. [*under development*]

10.2 Compile site-specific information on resource consumption: Information on energy, fuel, and water usage would be collected through other key actions and compiled in a comprehensive data set available to regions and program offices. [*under development*]

10.3 Establish a process for quantifying achievements: The process will establish a baseline and assist in evaluating progress in reducing demands that site cleanups place on the environment and communities. Using this baseline, the program could aim toward specific targets such as reducing energy consumption by 20% or increasing use of alternative fuels/renewable energy by 15%, consistent with selecting and implementing responses under the NCP. [*under development*]

As the Superfund Remedial Program moves forward with finalizing this Strategy, it is proceeding with implementing many of the Strategy's specific actions. For example, green remediation approaches are being considered in optimization evaluations underway this fiscal year, and green remediation liaisons have been named for each regional office.

A detailed implementation plan will be developed for each of the action items contained in the Strategy. The plan will identify actions to be taken, the persons responsible for each action, and an associated schedule.

Appendix A: Abbreviations and Acronyms

ARAR	applicable or relevant and appropriate requirement
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
DOE	U.S. Department of Energy
EE/CA	engineering evaluation/cost analysis
EO	executive order
EPA	U.S. Environmental Protection Agency
ER3	Environmentally Responsible Redevelopment and Reuse Initiative
ERRS	Emergency and Rapid Response Services
FFEO	Federal Facilities Enforcement Office
FFRRO	Federal Facilities Restoration and Reuse Office
GHG	greenhouse gas
IA	interagency agreement
ITRC	Interstate Technology and Regulatory Council
NARPM	National Association of Remedial Project Managers
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NRMRL	National Risk Management Research Laboratory
OEM	Office of Emergency Management
OSC	on-scene coordinator
OSRE	Office of Site Remediation Enforcement
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PA/SI	preliminary assessment/site investigation
PRP	potentially responsible party
RA	remedial action
RAC	remedial action contract
RD	remedial design
REC	renewable energy certificate
RI/FS	remedial investigation/feasibility study
RPM	remedial project manager
RSE	remediation system evaluation
SOW	statement of work
SRI	Superfund Redevelopment Initiative

Appendix B: References

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