

EPA Office of Solid Waste and Emergency Response (OSWER) Study information:

- Green Remediation
 - 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*. Green remediation also involves taking the steps to minimize the cleanup footprints, when appropriate, while continuing to satisfy threshold requirements for protectiveness and to meet other site-specific cleanup objectives intended to restore contaminated lands. Green remediation is intended to reduce the demand placed on the environment during cleanup actions and to conserve natural resources. Like all activities, each stage of the remedial process (discovery, assessment, characterization, design and construction, operation of treatment and containment remedies, monitoring and maintenance of remedies, etc.) produces an environmental footprint.
 - 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
 - OSWER has identified **five core elements** of green remediation
 - **Energy:** Green remediation strategies focus on opportunities to improve energy efficiency and use renewable energy sources.
 - **Air and atmosphere:** 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 may be reduced by applying the most appropriate advanced technologies and sound field practices.
 - **Water:** Green remediation strategies focus on reducing water consumption, reusing treated water, and using efficient techniques to manage and protect surface water and groundwater.
 - **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 may use 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 remediation strategies offer opportunities to reduce materials consumption and waste generation, use recycled and local materials and spent products, and purchase environmentally preferred products.
- Recommended Elements for Greener Cleanup Environmental Footprint Assessments and Best Practices
 - OSWER cleanup programs should consider these recommended elements when carrying out greener cleanup environmental footprint assessments and evaluating best practices that may be useful during the cleanup process.
 - Minimize Total Energy Use and Maximizes Use of Renewable Energy
 - Minimize energy consumption (e.g. use energy efficient equipment)
 - Power cleanup equipment through onsite renewable energy sources
 - Purchase commercial energy from renewable resources
 - Minimize Air Pollutants and Greenhouse Gas Emissions
 - Minimize the generation of greenhouse gases
 - Minimize generation and transport of airborne contaminants and dust
 - Use heavy equipment efficiently (e.g. diesel emission reduction plan)
 - Maximize use of machinery equipped with advanced emission controls
 - Use cleaner fuels to power machinery and auxiliary equipment
 - Sequester carbon onsite (e.g., soil amendments, revegetate)
 - Minimize Water Use and Impacts to Water Resources
 - Minimize water use and depletion of natural water resources
 - Capture, reclaim and store water for reuse (e.g. recharge aquifer, drinking water irrigation)
 - Minimize water demand for revegetation (e.g. native species)
 - Employ best management practices for stormwater
 - Reduce, Reuse and Recycle Material and Waste
 - Minimize consumption of virgin materials
 - Minimize waste generation
 - Use recycled products and local materials

- Beneficially reuse waste materials (e.g., concrete made with coal combustion products replacing a portion of the Portland cement)
 - Segregate and reuse or recycle materials, products, and infrastructure (e.g. soil, construction and demolition debris, buildings)
- Protect Land and Ecosystems
 - Minimize areas requiring activity or use limitations (e.g., destroy or remove contaminant sources)
 - Minimize unnecessary soil and habitat disturbance or destruction
 - Minimize noise and lighting disturbance
- Regulations
 - Green remediation strategies are derived from CERCLA and NCP frameworks but also involve concepts from 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.
 - The Energy Policy Act of 2005, for example, 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 on alternative energy resources.
 - Executive Order (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, further states 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).
 - EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, uses the framework provided by EO 13423 to establish an integrated strategy towards sustainability in the federal government. EO 13514 requires federal agencies to:
- Increase energy efficiency;
 - Measure, report, and reduce GHG emissions from direct and indirect sources;
 - Conserve and protect water resources through efficiency, reuse, and stormwater management;
 - Eliminate waste, recycle, and prevent pollution;
 - Leverage agency acquisitions to foster markets for sustainable technologies and environmentally preferable materials, products, and services;
 - Design, construct, maintain, and operate high performance buildings in sustainable locations; and
 - Strengthen vitality and livability of communities where federal facilities are located (EO, 2009).
 - In context of EO 13514, EPA activities include government remediation of Superfund sites. Draft guidance on federal GHG accounting and reporting

indicates that emissions associated with this activity are subject to "scope 3" voluntary reporting.⁶ As a related matter, many states are adopting climate legislation and policies, creating climate action plans, and providing incentives to create renewable energy projects.⁷ 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.