Renewable and Alternative Energy at Superfund Sites

HARNESSING NEW SOURCES OF POWER

Introduction

This report provides interested parties – local governments, communities, utility and energy companies, and federal and state agencies – with an overview of renewable and alternative energy opportunities at Superfund sites. Renewable energy facilities can be located on formerly contaminated lands. Renewable energy can also facilitate the cleanup of Superfund sites. In some cases, site wastes can serve as an alternative energy resource. Finally, the report describes available resources for parties interested in pursuing these opportunities.

To ensure domestic energy security and environmental sustainability, the identification of diversified, renewable and alternative energy sources is a long-term national priority. In 2008, EPA launched a new effort – the Siting Renewable Energy on Contaminated Land and Mining Sites Initiative – to highlight opportunities for the development of clean and renewable energy projects on contaminated lands.

EPA is also working to help turn these opportunities into reality for communities across the country. EPA's Superfund Redevelopment Initiative (SRI) helps communities reclaim and reuse contaminated lands for a wide range of purposes, including renewable and alternative energy generation. Through tools, partnerships and activities, SRI continues to provide local communities with new opportunities to grow and prosper.

To date, several significant opportunities have been realized. In Lackawanna, New York, the Steel Winds project has transformed a former slag pile into a 20-megawatt wind energy facility. In Rose Township, Michigan, soybeans, corn, sunflowers, canola and switchgrass planted at a former sludge disposal site have been harvested for the production of renewable biofuels. A rocket testing facility in California is now the location of one of the largest industrial solar systems in the country. Nationwide, there are at least 34 Superfund sites in planned or actual renewable energy reuse; several of these sites are also using renewable energy technologies as part of green remediation strategies for site cleanups.

What's Inside?

2.5-megawatt wind turbines at the Steel Winds project in Lackawanna, New York. Source: First Wind

Superfund Sites and Renewable Energy

Evaluating the capacity of Superfund sites to support renewable energy facilities is in some ways no different than a standard site evaluation process for potential wind, biomass, solar or geothermal capacity. Key evaluative criteria include:

- Availability and quality of the resource (e.g., wind, biomass, solar).
- Acreage.
- Distance to electric transmission lines or other infrastructure.
- Distance to graded roads.
- Site slope and aspect.

There are several reasons why Superfund sites and other contaminated lands can be well-suited for renewable energy production.

#1: Remote Locations, Large Size

Eighty percent of federally tracked contaminated lands, including Superfund sites, are in non-urban/remote locations. In addition, some non-urban/remote Superfund sites are large, encompassing thousands or tens of thousands of acres. Many sites have the capacity to support community- and utility-scale renewable energy facilities, while the revitalization of these lands provides economic value for site properties with lower conventional economic development potential.

#2: Urban and Suburban Locations, Small Size

Twenty percent of federally tracked contaminated lands, including Superfund sites, are smaller in size and located in urban and suburban areas, meeting the needs of a different range of community-scale and utility-scale renewable energy projects.

#3: Availability of Infrastructure

Many Superfund sites are located near public utilities, water and sewer, and transportation networks due to the infrastructure requirements of past land uses. Accordingly, energy projects' infrastructure development costs can be reduced.

#4: Green Remediation and Waste-into-Energy Recycling

At Superfund sites where cleanup planning is underway, renewable energy technologies can provide power for remedy components. Wind turbines can provide energy for mobile air quality monitoring laboratories. Solar photovoltaic arrays can be used to power physical and chemical treatment remedies. At other Superfund sites – and former landfill sites in particular – site waste can serve as an alternative energy resource.

2010 Update: EPA-Tracked Sites

In 2010, EPA's Office of Solid Waste and Emergency Response Center for Program Analysis, in partnership with the National Renewable Energy Laboratory, updated maps that demonstrate the viability of siting renewable energy on contaminated lands, including Superfund sites. The Superfund sites evaluated are those included in the EPA OSWER Cross-Program Revitalization Measure (CPRM) universe as of 2010. From this inventory, EPA extracted sites with acreage and viable latitude and longitude data. Key findings include:

- ***Biomass:*** 367 of the Superfund sites screened can support biopower facilities – plants or refineries that use biomass to generate energy. The sites are located across the country, with site clusters in California, the Northeast and the South.

- ***Wind Energy:*** 34 of the Superfund sites screened have community-scale wind resources; they are located nationwide. The six Superfund sites screened with utility-scale wind resources are located west of the Mississippi River, in Nebraska, California, Texas, North Dakota and Wyoming.

- ***Solar Energy (PV):*** 63 of the Superfund sites screened can support photovoltaic arrays. These sites are located west of the Mississippi, with clusters of sites in California, Arizona and Colorado and coverage across Idaho, New Mexico, Oklahoma, South Dakota, Texas, Utah and Wyoming.

- ***Solar Energy (CSP):*** 19 of the Superfund sites screened can support concentrated solar power systems, which use lenses or mirrors to concentrate solar energy. The sites are located in Arizona, California, New Mexico and Texas.

- ***Non-Grid Resources:*** Approximately 1,270 of the Superfund sites screened are not linked to the utility grid, but have community-scale or utility-scale wind resources (149 sites) and/or can support PV solar technologies (1,124 sites). These sites are located across the country.

These findings suggest that renewable energy represents a significant, viable reuse opportunity for Superfund sites and other contaminated lands in the future. Next, the report takes a look at several Superfund sites where wind, biomass and solar energy facilities are already providing benefits in communities.

Taking a Closer Look: Renewable Energy Projects at Superfund Sites

Case Study #1: Wind Energy Lackawanna, New York

In Lackawanna, New York, the blades of eight 2.5-megawatt utility-scale turbines turn in the wind, generating enough electricity to serve the needs of approximately 9,000 New York homes. The Steel Winds project has transformed a former Superfund site into a renewable energy resource. In so doing, the project has helped to sustain the community and helped turn around a regional industrial economy in decline.

The City of Lackawanna, located on the shore of Lake Erie just south of Buffalo, was the center of steel production in the region during the early 20th century. Declining domestic demand for steel production and competitive global markets led to the plant closing its doors in the mid-1980s. Contamination from the steel plant's activities resulted in the facility's designation as a Superfund site.

Construction of a wind turbine foundation for the Steel Winds project. Source: First Wind

Twenty years later, two energy companies – BQ Energy and UPC Wind – expressed interest in the site as a potential location for a wind farm; in 2006, EPA declared that portions of the site were clean enough to be reused.

The companies worked with the New York Department of Environmental Conservation to research wind patterns and evaluate environmental impacts. The resulting studies indicated that the site could support a utility-scale wind farm. At the same time, the companies also worked closely with Lackawanna City Council to obtain local approvals.

By early 2007, eight Clipper Liberty windmills were under construction on a 30-acre portion of the former Bethlehem Steel facility. Known as Steel Winds, the project is the largest urban wind farm in the United States, and the first to be located on a former Superfund and industrial brownfield site. Building on the successful development of Steel Winds, the City of Lackawanna is moving a rail line and extending new roads to facilitate the redevelopment of the surrounding, 400-acre former industrial area along Lake Erie.

Today, Steel Winds is a 20-megawatt wind farm now owned by the wind energy company First Wind; the company plans to install as many as 27 turbines in coming years. In turn, the project has spurred new energies and ideas in Lackawanna. As Norman L. Polanski Jr., the city's Mayor and a former Bethlehem Steel worker, stated in a 2007 newspaper article, "It's changing the image of the City of Lackawanna. We were the old Rust Belt, with all the negatives. Right now, we are progressive and we are leading the way on the waterfront."

Wind Energy Overview

According to the U.S. Department of Energy, wind is the fastest-growing energy source in the world. American wind farms generated an estimated 35,000 megawatts of wind energy in 2009, just over two percent of the U.S. electricity supply, powering the equivalent of nearly 10 million homes. This wind power capacity avoided an estimated 62 million tons of carbon dioxide emissions, equivalent to taking 10.5 million cars off the road, and conserved about 20 billion gallons of water.

While wind power is not likely to replace fossil fuels in the near future, it is a key player in diversifying energy resources. The Department of Energy has concluded that if wind turbines were erected on six percent of the land in the contiguous United States, they could supply one-and-a-half-times as much electricity as the country now uses.

Case Study #2: Biomass Energy Rose Township, Michigan

At the Rose Township Dump Superfund site in southeastern Michigan, an innovative partnership between a private corporation, a nonprofit organization and Michigan State University is exploring how biomass – organic material made from plants or animals – can be used as an alternative energy source. The ongoing research at the site is working with soybeans, corn, sunflowers, canola and switchgrass to develop biofuels like biodiesel, helping to determine how contaminated lands might be able to support the development of biomass as an alternative, renewable energy source.

The Rose Township Dump site is located approximately 40 miles northwest of Detroit and is primarily surrounded by wetlands and wooded areas. The site was farmland through the 1950s, but was used as a waste dump starting in the 1960s. As a result of the dumping, site soil and ground water were contaminated with polychlorinated biphenyls (PCBs), lead and volatile organic compounds (VOCs). To date, the site's cleanup has removed many of the site's contaminants; soil and ground water are being treated over the long term to ensure the protection of human health and the environment.

The alternative energy research at the Rose Township Dump is a small-scale pilot project; two acres of the 110-acre site are currently being used for the biofuels research. To date, the project's results have been promising. As of 2010, three seasons of crops have been planted and harvested at the site; current research indicates that the resulting biomass is comparable to biomass generated from crops planted on conventional farmland. Thanks to the research at the site, the development of biomass and biofuels is approaching broad-scale applicability at other Superfund sites across the country.

Biofuels Overview

A variety of fuels can be produced from biomass resources, including liquid fuels, such as ethanol, methanol, biodiesel and gasoline, and gaseous fuels, such as hydrogen and methane. Biofuels are primarily used to fuel vehicles, but can also fuel engines or fuel cells for electricity generation. Biodiesel is the primary biofuel under development at the Rose Township Dump site.

Biodiesel is a clean burning fuel produced from organic materials. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in compression-ignition (diesel) engines with little or no modification. Biodiesel is simple to use, biodegradable and non-toxic.

Biodiesel is made through a chemical process called transesterification; glycerin is separated from the fat or vegetable oil. The process leaves behind two products, methyl esters (the chemical name for biodiesel) and glycerin (a byproduct used in soaps and other products).

Pilot test crops planted for biofuels production at the Rose Township Dump Superfund site.
Source: Michigan State University

Case Study #3: Solar Energy
Rancho Cordova, California

With renewable energy providing a steadily increasing share of the nation's energy resources, more of the sun's rays are being converted into other forms of energy, such as heat and electricity. At a 40-acre facility near Sacramento, 22 solar arrays track the course of the sun, generating six megawatts of power. The solar farm is one of the largest single-site industrial installations in the United States.

This facility is remarkable for two reasons. First, it illustrates the dramatic growth of grid-connected, utility-scale photovoltaic (PV) systems in the United States. Between 2000 and 2008, the capacity of these systems nationwide grew from less than 20 megawatts to more than 500 megawatts, an average annual growth rate approaching 60 percent. Second, the solar farm is located on the Aerojet General Corporation Superfund site, a rocket propulsion development and testing facility.

Aerojet's solar farm is the latest and largest in a series of renewable energy facilities sited on current and former contaminated lands nationwide. Aerojet installed the solar farm to help power the site's extensive ground water remediation program, reducing the company's carbon footprint and improving energy usage as part of parent company GenCorp's Sustainability Initiative. The facility also restores the land to beneficial use as an energy-producing environmental asset.

"Aerojet is dedicated to reducing our overall environmental footprint," said company Vice-President Ronald Samborsky. "We recognize that our company uses a significant amount of energy, and our goal is to use the best combination of tools and approaches possible to reduce our overall footprint and rely on as much renewable energy as possible."

Solar Energy Overview

Solar energy is abundant – the sun's rays exceed 8,000 times our energy supply, providing Earth with as much energy every hour as humans use globally every year, according to a 2006 *Nature* article.

Solar energy currently provides less than 1 percent of the country's electricity supply. As of 2011, with technological and storage challenges being addressed and other dynamics changing, including increased demand, enhanced government incentives, rising energy prices and climate change concerns, the future for solar energy in the United States appears to be quite bright.

In 2008, for example, companies announced plans for two new solar plants that, according to *The New York Times*, will "generate more than 12 times as much electricity as the largest such plant today, the latest indication that solar energy is starting to achieve significant scale." The plants will cover 12.5 square miles and generate 800 megawatts of power on a sunny day, approximate to the scale of a large coal-burning power plant. Construction is scheduled to begin in 2011, with completion of the plants in 2014.

The Aerojet solar farm location prior to construction, 2009.
Source: Aerojet

Aerojet's solar farm helps power the site's ground water cleanup and is one of the largest industrial installations in the United States.
Source: Aerojet

Case Study #4: Geothermal Energy Fernald, Ohio

The 1,050-acre Fernald Environmental Management Project Superfund site is a former U.S. Department of Energy (DOE) uranium processing facility located in southwestern Ohio, 19 miles northwest of Cincinnati. Following the site's cleanup by DOE, the site is being returned to multiple recreational and ecological uses, including recreational trails, wetlands, wildlife habitat and a multi-use visitor center. The recreational and ecological area, operated by DOE's Office of Legacy Management, is called the Fernald Preserve.

The Fernald Preserve's visitor center is an adaptively reused steel warehouse that was built in 2000 as part of the site's cleanup. The 10,800- square-foot, $3-million project broke ground in December 2007; the facility opened in summer 2008. Recipient of the first Platinum LEED certification for sustainability in Ohio, the visitor center features occupancy sensors, dual-flush toilets, low-flow plumbing fixtures, low-VOC finishes, an on-site bio-wetland that processes building wastewater, and a geothermal heating and cooling system that has reduced energy consumption by 50 percent.

Today, visitor center exhibits present information on the site's history and ecology, while community organizations meet in the facility's meeting rooms and office space.

One challenge for the geothermal system faced by the project's design team was addressing the site's high water table, which did not allow the system to be installed deep enough underground to meet specifications. Instead, a nearby lake was used as the heat source.

Geothermal Energy Overview

According to the U.S. Department of Energy, the use of geothermal energy for human consumption involves utilizing the energy and thermal properties of heat flowing from the Earth's core, stream reservoirs, hot water and hot dry rocks. Geothermal energy is considered a renewable energy resource because the Earth produces an almost unlimited amount of heat.

The United States is the global leader in geothermal capacity and generation. Geothermal energy in the United States currently generates 15 billion kilowatt-hours of electricity annually, approximately 0.3 percent of the country's electricity supply, according to the Energy Information Administration.

The site's warehouse prior to renovation (left), during renovation (above top) and in adaptive reuse as the Fernald Preserve visitor center (above bottom). Source: glaserworks architecture

Renewable Energy and Green Remediation

The renewable energy resources discussed in this report also have direct application for green remediation – the practice of considering all environmental effects of remedies and incorporating options to maximize the environmental benefits of cleanups. Examples of green remediation and renewable energy technologies in action at Superfund sites across the country are presented below.

Norwood PCBs Superfund Site, Norwood, Massachusetts

A 26-acre site with a vapor mitigation system designed to address the site's ground water PCB contamination. Powered by a wind turbine, the system converted the contamination into a gas, which was then removed by activated carbon.

Pemaco Maywood Superfund Site, Maywood, California

A small solar PV assembly capable of producing 4,500 kilowatt-hours of electricity annually was installed on site building rooftops in 2007. The three-kilowatt solar panels supply power to the site's remediation system, which includes vacuum pumps to draw contaminants out of site soil and ground water and heat the soil via electrical resistance heating to allow for vaporized contaminant extraction.

Apache Powder Company Superfund Site, St. David, Arizona

The site's remedy included the construction of wetlands requiring water recirculation for the treatment of heavy metals, arsenic, fluoride and nitrate, as well as the maintenance of vegetated growth in an arid environment. Solar panels provided power to pump five gallons per minute through a 100-foot length of fire hose over a ten-foot elevation rise. Solar panels were also used in the treatment of contaminated ground water that could not be addressed by the constructed wetlands; the panels enabled the pumping and forced evaporation of these contaminants. A mini-solar PV panel still powers the flow meter, measuring the volume of water moving through the wetlands.

Summitville Mine Superfund Site, Del Norte, Colorado

Innovative management of contaminated surface water at the Summitville Mine site includes a 35-kilowatt hydroelectric facility that partially powers the plant that treats acid mining-impacted waters at the site. Fabrication work on the plant's turbine was completed in 2010. The turbine was delivered to Summitville in early November and placed into operation in 2011.

Maximizing Environmental Outcomes

Cleaning up a hazardous waste site uses energy, water and other natural or material resources. As outlined in EPA's *Superfund Green Remediation Strategy* (2010), the Agency recognizes that much can be done to conserve natural resources, minimize waste generation and reduce energy consumption, consequently improving environmental performance of Superfund activities while fulfilling the Agency's mission to protect human health and the environment.

Examples of environmentally friendly technologies/approaches include: recovering landfill gas for energy production; using renewable energy systems to power on-site treatment systems; purchasing construction materials with recycled or rapidly renewable content; using non-potable water for dust suppression; and promoting sustainable reuse of formerly contaminated lands.

Installation of hydroelectric equipment at the Summitville Mine site in Colorado in 2010. Source: EPA

Alternative Energy: Waste Recycling at Superfund Sites

Energy production at Superfund sites extends beyond renewable energy. At some Superfund sites – and landfill sites in particular – site wastes can be recycled as an alternative energy resource. This section highlights several Superfund sites where landfill gas – methane – serves as an alternative energy resource that provides power for landfill operations, local businesses, schools and thousands of residences.

As of 2011, EPA's Landfill Methane Outreach Program estimated that approximately 540 landfill gas energy projects were in operation across the United States. Landfill gas electricity generation projects have a capacity of 1,680 megawatts and provide the energy equivalent of power for almost one million homes annually as a clean energy source. EPA estimates that an additional 520 landfills present opportunities for new project development.

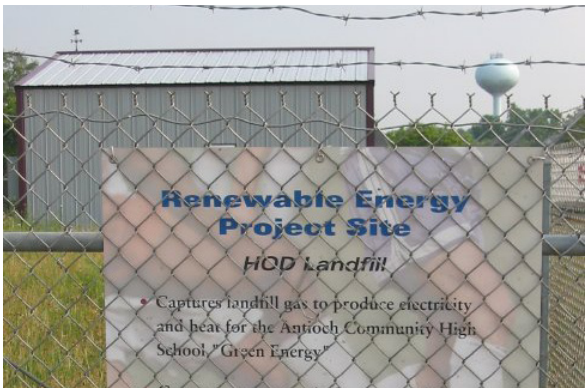
Southside Sanitary Landfill

The 312-acre Southside Sanitary Landfill in Indianapolis produces enough methane gas to serve as an energy resource for multiple local land uses, including Crossroads Greenhouses, one of the largest methane-powered greenhouses in the United States. All energy used in the greenhouse is extracted from the decomposing waste of the adjacent landfill. Each day, 2.2 million cubic feet of methane gas supply the greenhouse's energy demands. Annually, more than 400,000 poinsettias, bedding plants and hanging baskets are grown and supplied from the greenhouse.

Plants growing in one of the largest methane-powered greenhouses in the United States.
Source: Crossroads Greenhouse

H.O.D. Landfill

At the H.O.D. Landfill in Antioch, Illinois, methane gas generated by the former landfill is cleanly combusted as part of a methane co-generation system that provides low-cost energy to the nearby Antioch Community High School. The system provides the high school with 100 percent of its energy needs for electricity, heat and hot water, with estimated annual savings of $100,000. Excess capacity is sold back to the grid. The site has also been returned to use for recreational purposes, including soccer and softball fields, tennis courts and walking trails.



HOD Landfill methane powers a co-generation system that provides a low-cost community energy source. Source: EPA

Lowry Landfill

The 508-acre Lowry Landfill outside Denver, Colorado, operated as a municipal landfill for several decades. Following the site's cleanup, the City of Denver, Waste Management and local utility Xcel Energy partnered to find a productive use for the site's landfill gas. In 2007, construction began on a landfill gas-to-energy plant at Lowry Landfill and the adjoining Denver Arapahoe Disposal site. The plant opened in September 2008; it uses four combustion engines to convert 630 million cubic feet of methane gas annually from both sites into 3.2 megawatts of electrical power, reducing greenhouse gases and providing electricity for approximately 3,000 households.

The plant at Lowry Landfill and an adjacent site will generate 3.2 megawatts of power annually. Source: Waste Management

Taking a Look Back: Superfund Sites and Energy Opportunities

While detailed analysis is required to determine if a particular site is well-suited for one or more of the renewable or alternative energy opportunities outlined in this report, several broad conclusions can be drawn from this report's case studies and information review.

#1: *Superfund sites can support renewable energy facilities at all scales, from smaller-scale geothermal energy and remediation projects to utility-scale wind, solar and biomass operations.*

#2: *Renewable and alternative energy technologies can have low-impact physical "footprints" and be compatible with Superfund site remedies.*

#3: *Several renewable and alternative energy technologies – like wind turbines and methane gas conversion – are well-established at Superfund sites. Other renewable energy approaches – like the biomass and biofuels research at the Rose Township Dump site – are approaching readiness for broad-scale applications at other sites.*

#4: *Several renewable and alternative energy technologies present opportunities for green remediation, integrating site cleanup and energy generation and resulting in more efficient remedies, reduced greenhouse gas emissions and new energy resources.*

#5: *Reusing Superfund sites for renewable and alternative energy opportunities requires coordination with additional parties. At each of the sites discussed in this report, local governments, site owners, land users and technical specialists worked with EPA and state agency staff to understand site conditions and evaluate renewable and alternative energy reuse opportunities.*

#6: *Resources are available to support renewable and alternative energy opportunities at contaminated lands. The resources and references on the following pages provide additional information as well as references for the case studies presented in the report.*

Superfund sites can support renewable energy facilities at all scales, from smaller-scale geothermal energy and remediation projects to utility-scale wind, solar and biomass operations. Sources: EPA and Aerojet

For More Information

- ***EPA's Superfund Redevelopment Initiative (SRI)*** provides tools, case studies and resource information addressing the reuse of Superfund sites. For more information, contact Melissa Friedland, EPA's National Program Manager for Superfund Redevelopment, at 703-603-8864 / friedland.melissa@epa.gov or Project Officer Frank Avvisato at 703-603-8949 / avvisato.frank@epa.gov.
  Website: http://www.epa.gov/superfund/programs/recycle

- ***EPA's RE-Powering America's Land Initiative*** identifies the renewable energy potential of contaminated lands and serves as a resource for parties interested in reusing these lands for renewable energy development. EPA estimates that there are approximately 490,000 sites and almost 15 million acres of potentially contaminated properties across the United States that are tracked by EPA. Through coordination and partnerships among federal, state, tribal and other government agencies, utilities, communities and the private sector, EPA and its partners are exploring how new renewable energy facilities can be developed on these properties. The website also provides links to state-level renewable energy incentive sheets and provides maps highlighting contaminated lands with the potential capacity to support renewable energy-related land uses.
  Websites: http://www.epa.gov/renewableenergyland and http://www.epa.gov/oswer/ocpa/maps_incentives.htm

- ***EPA's Clean Energy Programs*** provide information and technical assistance on clean energy technologies, green power resources, and state and local programs.
  Website: http://www.epa.gov/cleanenergy/index.html

- ***EPA's Green Remediation Strategy*** fosters the use of best management practices for green remediation at contaminated sites. Green remediation is the practice of considering all environmental effects of remedy implementation and incorporating options to maximize the environmental benefits of cleanups. By incorporating the use of renewable energy sources, EPA and its partners are maintaining the effectiveness of remediation methods while reducing greenhouse gas emissions from conventional power sources.
  Website: http://www.epa.gov/superfund/greenremediation

- ***EPA's Green Power Partnership*** is a voluntary program that supports the organizational procurement of green power – electricity produced from renewable resources – by offering expert advice, technical support, tools and resources. Partnering with EPA helps organizations lower the transaction costs of buying green power, reduce their carbon footprints and communicate their environmental leadership to stakeholders. To date, more than 1,200 organizations have joined the partnership, buying nearly 18 billion kilowatt- hours of green power annually.

- ***EPA's Abandoned Mine Lands Team*** provides communities with reuse-related technical support and resources for Superfund sites that are also former mining areas.
  Website: http://www.epa.gov/aml/revital/index.htm

Resources

Resource	Organization	Program Description	Contact Information
General Resources			
Wind Technologies Program	U.S. Department of Energy (DOE)	DOE's Wind Technologies Program offers general information, research funding and technical assistance.	http://www1.eere.energy.gov/windandhydro
American Wind Energy Association (AWEA)	American Wind Energy Association (AWEA)	AWEA provides resources for all relevant information regarding wind energy in the United States.	http://www.awea.org
Biomass Program	U.S. Department of Energy (DOE)	DOE's Biomass Program offers general information, research funding and technical assistance.	http://www1.eere.energy.gov/biomass/about.html
Conservation Plant Material Centers	USDA Natural Resources Conservation Service (NRCS)	USDA's NRCS provides information on the use of native plants for biomass production through its Conservation Plant Material Centers.	http://www.plant-materials.nrcs.usda.gov
Solar Energy Technologies Program	U.S. Department of Energy (DOE)	DOE's Solar Energy Technologies Program offers general information, research funding and technical assistance.	www1.eere.energy.gov/solar
Solar Energy Industries Association	Solar Energy Industries Association	National trade association website provides information about state and federal issues, as well as current news and research.	http://www.seia.org
Geothermal Technologies Program	U.S. Department of Energy (DOE)	DOE's Geothermal Technologies Program offers general information, research funding, and technical assistance.	http://www1.eere.energy.gov/geothermal
Cleanup-Clean Air Program	EPA Region 9	EPA program that addresses greenhouse gas emissions and fossil fuel use associated with Superfund site remediation.	http://www.epa.gov/region09/cleanup-clean-air/index.html
EPA Resources			
EPA Superfund Redevelopment Initiative	EPA Office of Superfund Remediation and Technology Innovation (OSRTI)	EPA initiative focused on the reuse of Superfund sites.	http://www.epa.gov/superfund/programs/recycle
EPA ER3 Initiative -ER3 Pilot Projects	EPA Office of Site Remediation Enforcement (OSRE)	EPA initiative focused on the sustainable cleanup and redevelopment of contaminated sites.	http://www.epa.gov/oecaerth/cleanup/revitalization/er3/index.html
Landfill Methane Outreach Program	EPA	EPA voluntary assistance and partnership program focused on the use of landfill gas as a renewable, green energy source.	http://www.epa.gov/lmop
Renewable Energy Program	EPA and DOE National Renewable Energy Laboratory (NREL)	Program provides links to state-level renewable energy incentive sheets and maps highlighting contaminated lands with the potential capacity to support renewable energy-related land uses.	http://www.epa.gov/oswer/ocpa/maps_incentives.htm

Resource	Organization	Program Description	Contact Information
EPA Resources (continued)			
EPA Clean Energy Programs	EPA	EPA's Clean Energy Programs provide information and technical assistance on clean energy technologies, green power resources and state and local programs.	http://www.epa.gov/cleanenergy/index.html
EPA Small Business Liability Relief and Brownfields Revitalization Act	EPA	EPA-provided information on bona fide prospective purchaser requirements and the 2001 Brownfields Revitalization Act.	http://www.epa.gov/brownfields/aai/aaicerclafs.pdf
Environmental Insurance and Contaminated Lands	EPA	EPA-provided information on indemnification and environmental insurance.	http://www.epa.gov/brownfields/insurance
Case Study Resources			
Steel Winds Project	*New York Times* newspaper article	2007 newspaper article summarizing the wind energy reuse of the Lackawanna Foundry Superfund site.	http://www.nytimes.com/2007/05/22/nyregion/22wind.html
Rose Township Dump Biofuels Project	Michigan State University	Overview of biomass and biofuels research at the Rose Township Dump site in Michigan.	http://www.maes.msu.edu/publications/futures/fall2006/brownfields_fall06.pdf
Aerojet General Corp. Solar Project	EPA Region 1	EPA SRI reuse case study summarizes the site's history and solar project.	http://epa.gov/superfund/programs/recycle/pdf/aerojet.pdf
Fernald Preserve Project	EPA Region 5	EPA site fact sheet summarizes its history and cleanup and recreational and ecological reuse, which includes a geothermal energy component.	http://www.epa.gov/region5superfund/npl/ohio/OH6890008976.htm
Southside Sanitary Landfill Project	EPA Region 5	EPA site reuse summary for the Southside Sanitary Landfill site in Indianapolis.	http://www.epa.gov/superfund/programs/recycle/live/region5_in.html
Lowry Landfill Project	City and County of Denver, Colorado, and Waste Management	City and County of Denver and Waste Management website for the Lowry Landfill site, which includes an overview of the site's landfill gas-to-energy plant.	http://www.lowrylandfillinfo.com

References

Introduction

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- Energy Administration Information Renewable and Alternative Fuels website, at: http://www.eia.doe.gov/fuelrenewable.html.
- EPA Clean Energy Programs website, at: http://www.epa.gov/cleanenergy/index.html.
- EPA Siting Renewable Energy on Contaminated Land and Mining Sites Initiative website, at: http://earth1.epa.gov/oswer/ocpa/index.htm.
- March 2011 *EPA Revitalizing Contaminated Sites: Addressing Liability Concerns Handbook*, at: http://www.epa.gov/compliance/resources/publications/cleanup/brownfields/handbook/bfhbkcmp-11.pdf.
- March 2008 EPA "Smart Energy Resources Guide," at: http://www.epa.gov/nrmrl/pubs/600r08049/600r08049.pdf.
- October 2007 NREL "Converting Limbo Lands to Energy-Generating Stations: Renewable Energy Technologies on Underused, Formerly Contaminated Sites" report, at: http://www.epa.gov/ORD/NRMRL/pubs/600r08023/600r08023.pdf.
- EPA Small Business Liability Relief and Brownfields Revitalization Act Web page, at: http://www.epa.gov/brownfields/aai/aaicerclafs.pdf.

Wind Energy and the Steel Winds Case Study

- 2008 interview with Paul Curran, Managing Director, BQ Energy.
- May 2007 *New York Times* article "An Old Steel Mill Retools to Produce Clean Energy," at: http://www.nytimes.com/2007/05/22/nyregion/22wind.html.
- U.S. Department of Energy's Wind and Hydropower Technologies Program website, at: http://www1.eere.energy.gov/windandhydro.
- U.S. Department of Energy's Wind Powering America Initiative website, at: http://www.eere.energy.gov/windandhydro/windpoweringamerica/index.asp.
- American Wind Energy Association's website, at: http://www.awea.org.
- American Planning Association's "Policy Guide on Energy," at: http://www.planning.org/policy/guides/adopted/energy.htm.
- Windustry website, at: http://www.windustry.org.
- National Renewable Energy Laboratory's Wind Energy Atlas of the United States, at: http://rredc.nrel.gov/wind/pubs/atlas/chp1.html.
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Renewable and Alternative Energy at Superfund Sites

HARNESSING NEW SOURCES OF POWER

Office of Solid Waste and Emergency Response
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Washington, DC

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