RE-POWERING AMERICA'S LAND INITIATIVE:

RE-POWERING MAPPER FACT SHEET

APRIL 2023

Office of Communications, Partnerships, and Analysis
Office of Land and Emergency Management

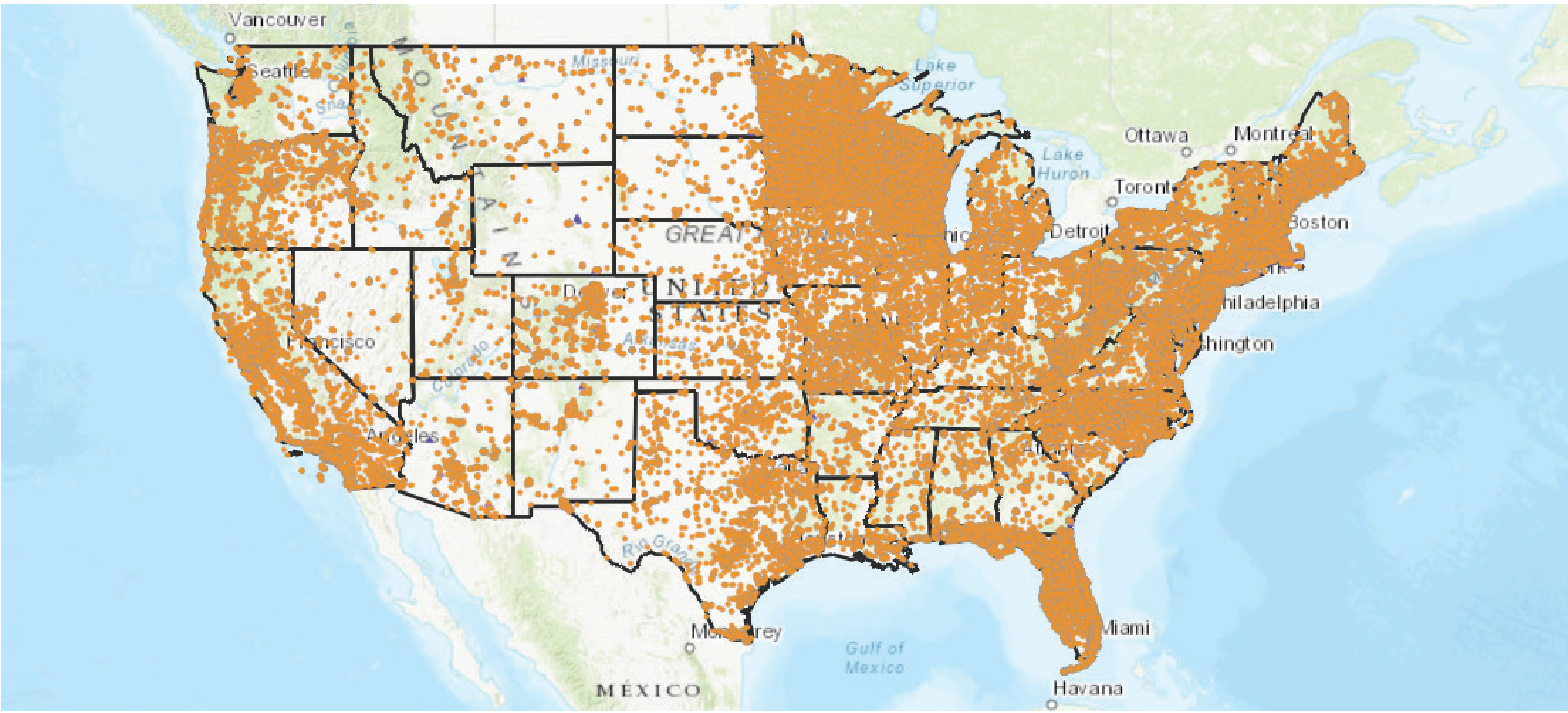
WHAT IS THE RE-POWERING MAPPER?

The RE-Powering Mapper is a Web-based geographic information tool developed by EPA's RE-Powering America's Land Initiative that provides information on location and renewable energy potential for contaminated lands, landfills and mine sites. The site data are collected from state and federal sources. Each screened site includes attributes such as resource capacity potential and proximity to electric transmission lines. Within the RE-Powering Mapper, users can filter, query and select sites that have pre-screened favorably for solar, wind, biomass/biofuel and geothermal energy potential. The Mapper is a first step in the process for finding contaminated lands to site renewable energy. Additional site-specific research and analyses are needed to verify viability for renewable energy project development at a given site.

What Sites were Screened?

In 2021, the RE-Powering Mapper screened over **190,000** sites for renewable energy potential. This includes **43,476** sites collected from EPA program databases, including: Superfund, Brownfields grantees, Resource Conservation and Recovery Act (RCRA) Corrective Action and the Landfill Methane Outreach Program.

An additional **147,500** sites were collected from state programs in California, Colorado, Connecticut, Florida, Hawaii, Illinois, Iowa, Maine, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Texas, Virginia, West Virginia and Wisconsin.



EPA

What is the Renewable Energy Potential of Screened Sites? [1]

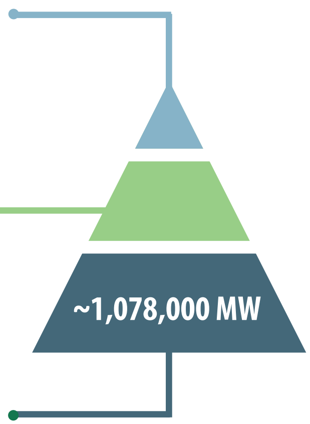
Using information gathered about the RE-Powering screened sites, technical potential can be estimated at these sites. Identifying technical potential at a site is the first step in the process of determining if renewable energy is a viable reuse of a site. After technical potential is determined to be sufficient at the site more site-specific information including economical information, market costs, technical constraints and policy considerations are reviewed for the site. Market and economic potential were not calculated for the RE-Powering screened sites because this information is locally dependent and subject to change, while technical potential does not have a cost element and not as likely to fluctuate over time.

Technical Potential for Screened RE-Powering Sites: over 1,078,000 MW

Market potential – The portion of the economic potential that could be achieved given current costs, policies and technical constraints.

Economic potential – The portion of the technical potential that is economically viable, but requires additional policies to break down market barriers.

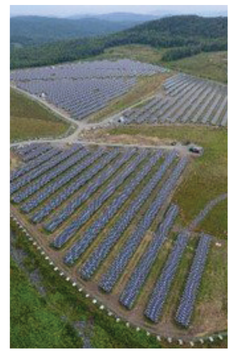
Technical potential – Potential that is technically possible, without consideration of cost or practical feasibility.



1 For renewable energy potential when a site screened positively for multiple renewable energy types, the type with the greatest capacity value was used. Duplicate sites may exist.

Overall Potential

Potential Installed Capacity Based on Percentage of Acreage Screened and Reused for Renewable Energy Development			
10% Of Acres **Over 107,800 MW**	25% Of Acres **Over 269,500 MW**	50% Of Acres **Over 539,000 MW**	100% Of Acres **Over 1,078,000 MW**




Results by Technology

	All Sites		
Screening Results	Sites	Acres	Est. Capacity *(MW)*
All Technologies	**190,976**	**39,604,078**	**1,078,000**
Solar	190,976	39,604,078	885,907
Wind	111,849	33,027,493	178,710
Biomass	31,037	33,452,225	347,040
Geothermal	190,956	39,603,987	N/A

Highlights and Opportunities

The screened sites represent thousands of acres of land with renewable energy development potential (see chart below). The reuse of these often under-utilized properties as renewable energy systems may represent an opportunity for cost savings, additional revenue and job growth for local communities. These projects can also help communities advance clean energy goals and reduce their greenhouse gas footprint.

Based on resource availability, site size and distance from existing infrastructure, the RE-Powering Mapper identified:

- **158,171 sites** screen positively for renewable energy potential in states that have a Renewable Portfolio Standard (RPS) or goal.
- **70,811 sites** screen positively for renewable energy potential in states that have a RE-Powering policy that encourages renewable energy on contaminated lands.
- **33,910 sites** screen positively for distributed-scale photovoltaic (PV) solar or larger in states that encourage community solar or other shared renewables.
- **82,090 sites** screen positively for off-grid solar and could be used on-site to reduce energy use or power green remediation.
- **3,667 sites** screened positively for biofuels.

Solar on Landfills

Closed landfills represent unique opportunities for developing solar resources. Landfills are typically located near transmission lines and roads, near population centers and cover larger areas with minimal grade. Most municipalities have landfills and the land costs are usually lower when compared to open spaces. The RE-Powering Mapper includes **18,298** landfills that screened positively for solar potential.

As of 2021, the RE-Powering Initiative has identified **297** completed solar on landfill projects generating **881.7 MW** of electricity. For example, the East Providence, RI, landfill is home to a **14-acre, 3.7-MW** solar project completed under a 15-year Power Purchase Agreement with the local utility. The project leveraged additional clean-up efforts by using gravel from a highway demolition project and compost from the landfill to cap the site.

*The RE-Powering mapper includes **18,298** landfills that screened positively for solar potential.*

EPA SUPERFUND	EPA BROWNFIELDS	EPA RCRA
1,885 sites	**35,067** sites	**3,864** sites
9 Million acres	**1.4 Million** acres	**15.3 Million** acres
149,297 MW capacity	**105,150** MW capacity	**214,066** MW capacity

MINE LANDS	LANDFILLS	STATE TRACKED
17,756 sites	**18,298** sites	**147,500** sites
1.5 Million acres	**491,639** acres	**13.5 Million** acres
89,525 MW capacity	**57,400** MW capacity	**272,346** MW capacity

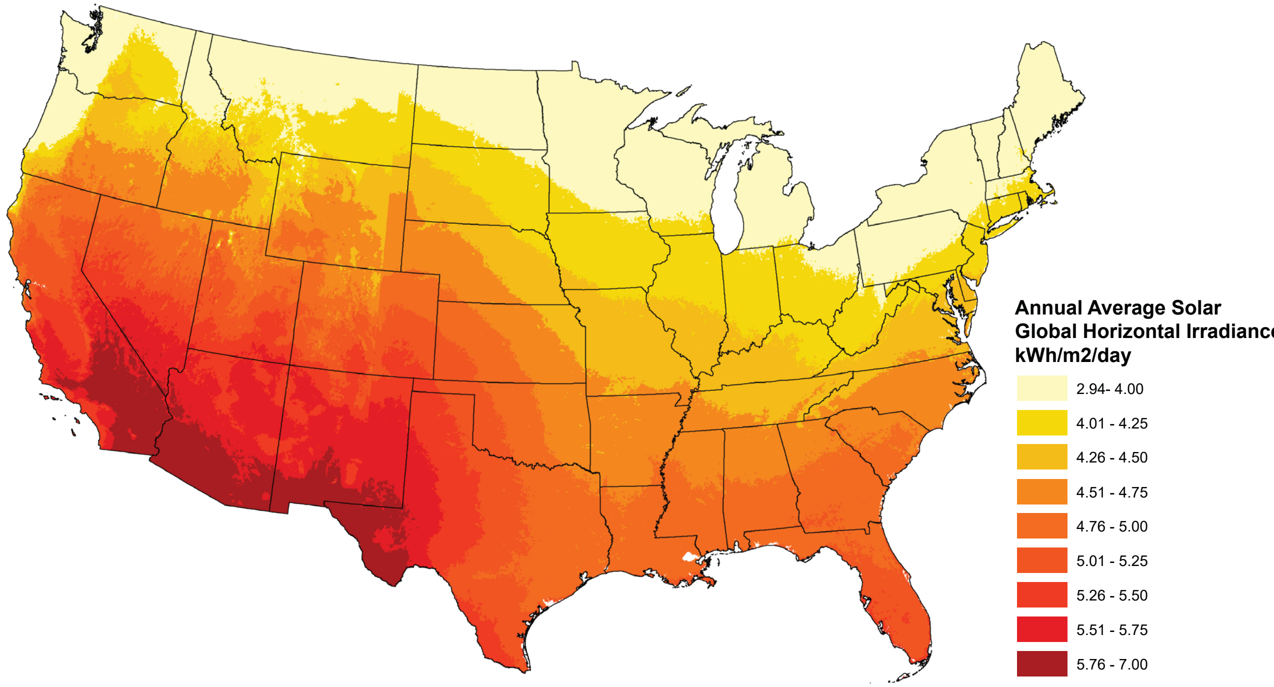
Solar Technologies

What is Solar Energy?

Solar technologies generate electricity from the sun's energy. There are several different types of solar energy technologies. The RE-Powering Mapper only includes solar PV technology. Solar PV converts the sun's light energy directly into electricity. PV technology is scalable; the amount of electricity generated is directly related to the number and efficiency of installed panels. It can technically be sited anywhere, though the economics may make a project unfeasible in lower resource areas. Four scales of solar PV were evaluated:

- **Utility Scale PV Solar** - Uses PV technology at the 5 MW and greater scale at sites with the greatest resource and acreage availability. Electricity generated is typically exported to the grid.
- **Distributed Scale PV Solar** - Uses PV technology at the 5 MW and lower scale at sites with strong resource and smaller acreage availability. Electricity generated may be exported to the grid or used to offset onsite electricity consumption, depending on site requirements and market conditions.
- **Off-grid PV Solar** - This category represents PV technology being used at a smaller scale, typically to power the energy needs of a single property when interconnection to the grid may not be feasible. Additional sites with lower solar resource may be technically and economically feasible depending on the potential for battery backup and cost barriers associated with grid interconnection (e.g., due to remote locations).
- **Unknown Acreage PV Solar** - These sites might be suitable for the above scales, but acreage information is not available.

Annual Average Solar Resource



PV Solar Results by Technology Scale

Screening Results	All Sites		
	Sites	Acres	Est. Capacity *(MW)*
Utility Scale PV	17,649	38,973,009	838,291
Distributed Scale PV	64,268	328,552	47,616
Off-Grid PV	82,090	39,604,078	N/A
Unknown Acreage PV	108,886	N/A	N/A

What are Examples of Successful Solar PV Projects on Contaminated Land?

RE-Powering America's Land Initiative tracks the installation of renewable energy projects on contaminated lands, landfills and mine sites:

Solar at an Abandoned Copper Mine—Developers installed a 7-MW solar PV array in 2017 at the Elizabeth Mine Superfund Site in Strafford, Vermont. The $65 million solar project is located on 28 acres of the abandoned copper mine, making productive use of land contaminated with sulfuric acid and metallic tailings (sulfide ore). Operating from the early 1800s through 1958, Elizabeth Mine was once the largest copper producer in the United States. The site's 150 years of mining activity contaminated groundwater, surface water and nearby streams, leading to a Superfund designation in 2001. Remedial action has addressed contamination, and EPA continues to monitor the cover system for the tailing impoundment as well as surface water and groundwater conditions. Developers began work on the 19,900-panel solar project in 2010. Because of the remote nature of the site, the developer had to coordinate with the local utility (Green Mountain Power) for an interconnection. The project included an upgrade of approximately four miles of utility lines, 10 miles of dedicated fiber optic communications line, and an upgrade to the regional substation. These grid upgrades benefited the community with a more reliable electrical system. In addition, developers used local civil, mechanical and electrical contractors for the project, driving employment for the local economy. It is estimated that the project avoids 6,000 tons of carbon dioxide (CO2) and provides electricity sufficient to power 1,200 homes annually.

Solar panels installed at the Elizabeth Mine project in Strafford, Vermont.

Solar for Groundwater Remediation—There are several cases in which PV solar facilities have been used to power groundwater remediation on Superfund sites, such as the Frontier Fertilizer site in Davis, California; the Pemaco site in Maywood, California; the Apache Powder site near Benson, Arizona; Lawrence Livermore National Laboratory near Livermore, California; and the Re-Solve chemical reclamation site in Dartmouth, Massachusetts. These solar projects provide significant energy cost savings and, in some cases, support groundwater treatment in remote areas that would otherwise require the installation of costly power lines or generators.

Solar panel installation at the Lawrence Livermore National Laboratory in California.

*The Elizabeth Mine Superfund Site project in Strafford, Vermont included an upgrade of approximately **four miles** of utility lines, **ten miles** of dedicated fiber optic communications line, and an **upgrade** to the regional substation.*

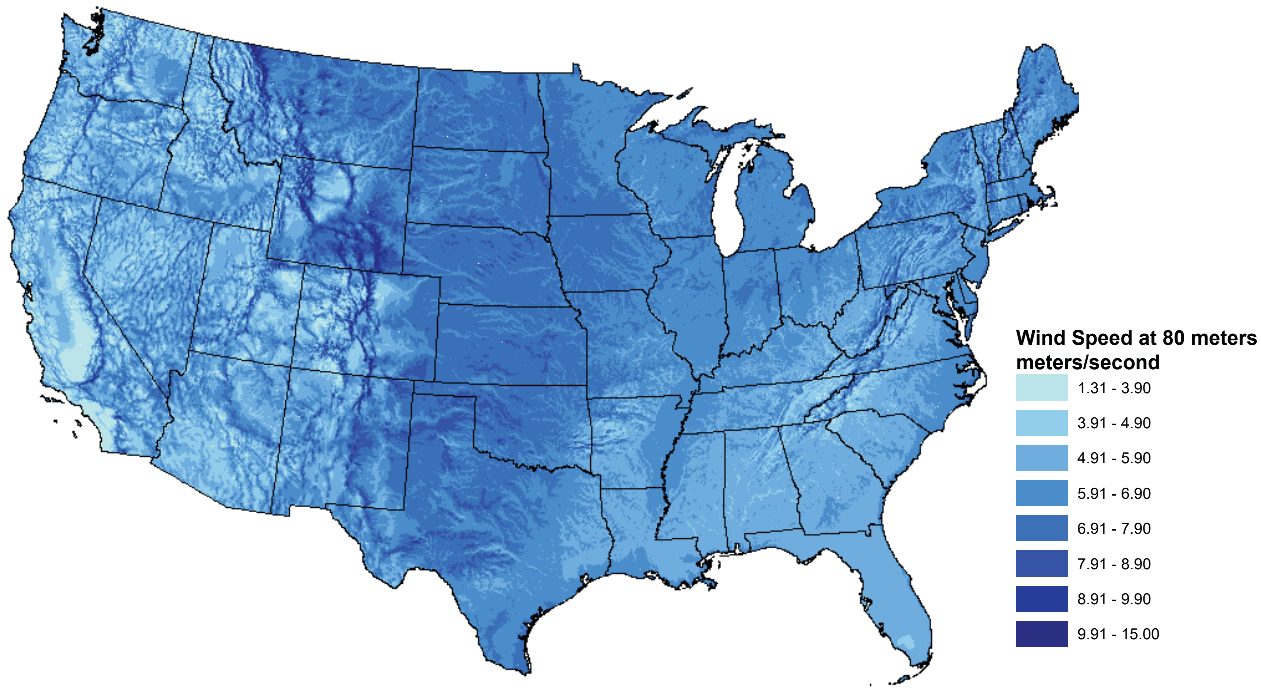
Wind Technologies

What is Wind Energy?

Wind energy is captured by wind turbines with propeller-like blades mounted on a tower. The force of the wind causes the rotor to spin and the turning shaft spins a turbine to generate electricity. Wind technology is scalable; based on site conditions, different turbine designs can be used to meet different electricity needs. The following types of wind production were evaluated:

- **Utility Scale Wind** – Uses wind technology at the 15 MW or greater scale at sites with the greatest resource and acreage availability. Electricity generated is typically exported to the grid.
- **Community Scale Wind** – Uses wind technology at the 1.5 to 15 MW scale at sites with strong resource and smaller acreage availability. Electricity generated may be exported to the grid or used to offset onsite electricity consumption, depending on site requirements and market conditions.
- **Facility Scale Wind** – Uses wind technology at the 1.5 MW or less scale at sites with limited acreage, potentially using a range of turbine sizes. Electricity generated may be distributed to the local area through the distribution system, often serving only adjacent properties, or more commonly to power the energy needs of a single property when interconnection to the grid may not be feasible.
- **Unknown Acreage Wind** – These sites might be suitable for the above scales, but acreage information is not available.

Wind Speed at 80 Meters



Wind Results by Technology Scale

Screening Results	All Sites		
	Sites	Acres	Est. Capacity *(MW)*
Utility Scale Wind	601	31,019,207	155,350
Community Scale Wind	9,770	1,868,763	23,359
Facility Scale Wind	18,851	139,521	N/A
Unknown Acreage Wind	82,627	N/A	N/A

What is an Example of a Successful Wind Energy Project on Contaminated Land?

The Bethlehem Steel Mill site, located in Hamburg and Lackawanna, New York, is now home to two wind projects totaling 35 MW of capacity. The site served as a steel mill for nearly 80 years before closing in the mid-1980s—leaving behind a 1,600-acre site contaminated with steel slag, industrial waste and mine acid drainage. The site became the subject of an EPA RCRA facility investigation in the 1990s. In 2006, EPA declared a 30-acre tract of the site suitable for a wind project, and developers worked with the state to place a protective cap and groundwater monitoring wells before installing 2.5-MW turbines. The installations were completed in phases, with one 20-MW, 8-turbine project completed in 2007 and the second 15-MW, 6-turbine project completed in 2012. The two projects combined provide approximately $190,000 in annual tax revenues for local communities and school districts and created five permanent green jobs and 140 construction jobs in an area with historically high unemployment.

Bethlehem Steel Site before cleanup.

Bethlehem Steel Site after renovation and construction.

*The two projects combined provide approximately **$190,000** in annual tax revenues for local communities and school districts and created **five permanent green jobs and 140 construction jobs** in an area with historically high unemployment.*

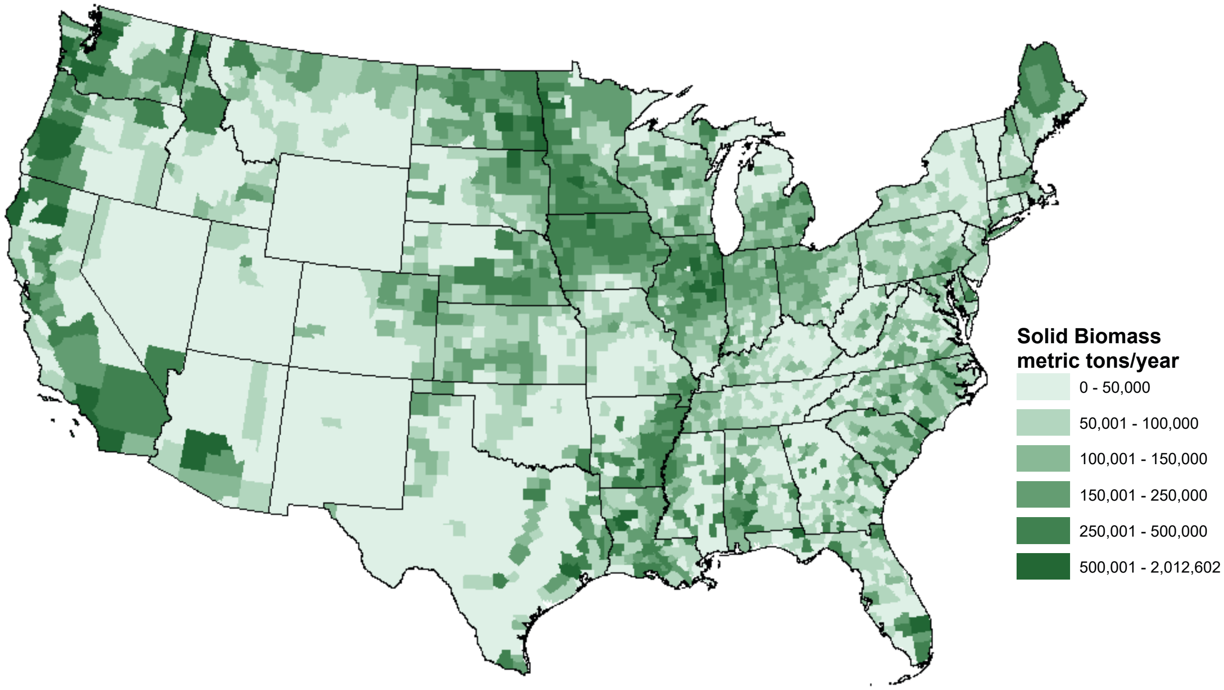
Biomass Technologies

What is Biomass Energy?

Biomass energy or "bioenergy" is generated from organic feedstocks. Wood is the largest biomass energy resource. Other sources of biomass include food crops, grassy and woody plants, residues from agriculture or forestry and the organic component of municipal and industrial wastes. These feedstocks can be used as a solid fuel or converted into liquid or gaseous forms to produce electric power, heat, chemicals or fuels. Two types of biomass production were evaluated:

- **Biopower facility** – Burns biomass resources to produce heat, which is used to boil water for a conventional steam-turbine generator to produce electricity. Biopower facilities use cumulative biomass resources that can include residues from woody stock such as forests, primary and secondary mills and urban wood waste.
- **Biofuels facility** – Integrates biomass conversion processes and equipment to produce fuels, power and chemicals from biomass. The technology uses cumulative herbaceous sources such as crop residues.

Solid Biomass Feed Stock by County



Biomass Results by Technology Type

Screening Results	All Sites		
	Sites	Acres	Est. Capacity *(MW)*
Biofuels facility	3,667	16,992,986	73,340
Biopower Facility	30,909	31,918,868	309,090

What is an Example of a Successful Biomass Energy Project on Contaminated Land?

The Savannah River Steam Plant in Aiken, South Carolina, is located on a federally owned Superfund site that was once home to a coal-fired steam plant. Today, the site features a 20-MW biomass-fueled steam cogeneration plant and two smaller biomass-fueled plants. The installations provide power for site operations for the U.S. Department of Energy's (DOE) National Nuclear Security Administration. The developer secured an Energy Savings Performance Contract (ESPC) to finance, design, construct, operate, maintain and fuel the facility under a 19-year fixed price contract valued at $795 million. The ESPC uses contractor-guaranteed savings in energy and operational costs to fund the project under a financed mortgage. The Savannah River biomass project provides an estimated $36 million in annual energy savings and contributes to DOE's renewable energy goals, while also reducing water consumption, lowering operating and maintenance costs, and reducing pollutant emissions.

The Savannah River Steam Plant in Aiken, SC.

The McNeil Station biopower facility in Burlington, VT.

*The Savannah River biomass project provides an estimated **$36 million** in annual energy savings and contributes to DOE's renewable energy goals, while also reducing water consumption, lowering operating and maintenance costs, and reducing pollutant emissions.*

Geothermal Technologies

What is Geothermal Energy?

Geothermal facilities use heat stored in the earth to generate electricity. This heat comes from the original formation of the planet, radioactive decay of minerals, tectonic activity and solar energy absorbed at the surface. Geothermal energy is unique when compared to other renewable energy resources because it is more closely related to mineral or conventional fossil fuel resources, due to subsurface characterization. One type of geothermal production was evaluated:

- **Geothermal heat pump –** The upper 10 feet of the Earth maintains a nearly constant temperature between 50° and 60°F (10°- 16°C). Geothermal heat pumps take advantage of this resource to heat and cool buildings and heat water. Geothermal heat pump systems consist of three parts: the ground loop heat exchanger, the heat pump unit and the air delivery system (ductwork). The ground loop heat exchanger is a system of pipes buried in the shallow ground near the building (or in a vertical well if land for a horizontal loop is limited). Water source heat pumps work on the same principle as ground source systems but use an adjacent body of water as the heat sink. A fluid (usually water or a mixture of water and antifreeze) circulates through the loop to absorb or relinquish heat within the ground. Geothermal heat pumps use much less energy than conventional heating systems since they draw heat from the ground. Geothermal heat pumps typically serve a single property, though they may also be viable for use in multi-tenant applications such as integrated district heating systems.

Geothermal Results by Technology Type

Screening Results	All Sites		
	Sites	Acres	Est. Capacity *(MW)*
Geothermal Heat Pump	190,956	39,603,987	N/A

Tech Town Campus. Photo courtesy of City Wide Development.

What is an Example of a Successful Geothermal Energy Project on Contaminated Land?

Dayton Tech Town, located in downtown Dayton, Ohio is a premier technology-focused business campus. The Creative Technology Accelerator (CTA) building is a sustainable facility that includes a geothermal heating and cooling system. Previously, the site was home to the General Motors (GM) Delphi Harrison Thermal System Facility. The GM plant occupied 40 acres and produced automotive air conditioning compressors and related components, electric refrigerators, household appliances and machine guns during World War II. There are documented incidents of spills of solvents, plating materials and petroleum products that were used in facility operations. The CTA building is certified Gold in the Leadership in Energy & Environmental Design (LEED) program. LEED certification recognizes green building and best-in-class building strategies and practices. The building is expected to save over $66,000 and 300,000 kilowatt-hours/year related to sustainable building and the geothermal system.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