RE-Powering America's Land Initiative

Renewable Energy Screening Factsheet

September 2018

Overview

Through its RE-Powering America's Land Initiative, the U.S. Environmental Protection Agency (EPA) encourages renewable energy development on current and formerly contaminated lands, landfills, and mine sites when such development is aligned with the community's vision for the site. The Initiative develops tools and resources to help interested parties identify potential sites. As part of this mission, the RE-Powering Initiative routinely screens sites for renewable energy potential and provides the results.

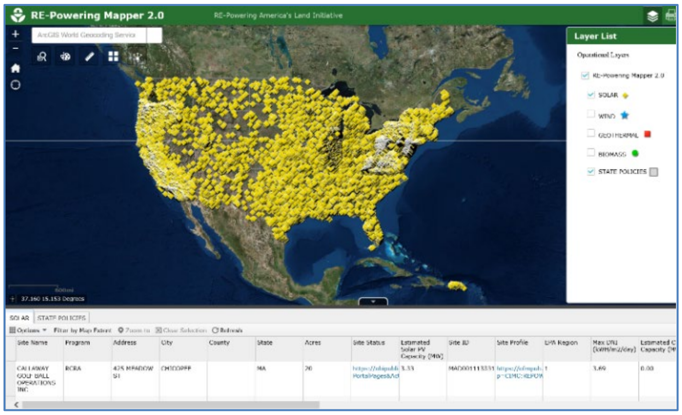
What is the RE-Powering Mapper?

The RE-Powering Mapper is a web-based geographic information tool that provides location and renewable energy potential information for contaminated lands, landfills, and mine sites. The site data are collected from state and federal sources. Each screened location 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.

What Sites Were Screened?

In 2018, over 130,000 sites were screened for renewable energy potential. This includes 36,400 sites collected from EPA program databases, including: Superfund, Brownfields grantees, RCRA Corrective Action, and the Landfill Methane Outreach Program.

An additional 97,500 sites were collected from state programs in California, Colorado, Connecticut, Florida, Hawaii, Illinois, Maryland, Massachusetts, Minnesota Missouri, New Jersey, New York, Oregon, Pennsylvania, Texas, Virginia, and West Virginia.



*What is the RE Potential of Screened Sites?**

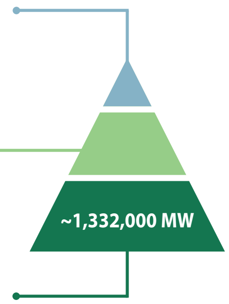
Estimated Renewable Energy Potential

Technical potential for EPA tracked sites: almost 1,332,000 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.



* *For Renewable Energy Potential known duplicates were removed. If a site screened positively for multiple renewable energy types the type with the greatest capacity value was used.*

Overall Potential

Potential installed capacity based on percentage of acreage screened and reused for renewable energy development			
10% OF ACRES	25% OF ACRES	50% OF ACRES	100% OF ACRES
OVER 133,000 MW	OVER 333,000 MW	OVER 666,000 MW	OVER 1,332,000 MW

Results by Technology

Screening Results	All Sites		
	Sites	*Acres*	*Est. Capacity (MW)*
All Technologies	133,890	43,968,753	1,332,842
Solar	133,890	43,933,587	1,090,146
Wind	64,935	38,166,920	348,184
Biomass	37,129	32,237,784	393,900
Geothermal	110,593	40,808,323	NA

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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:

- 114,830 sites screen positively for renewable energy in states that have an RPS.
- 8,445 sites positively for small scale utility solar or larger in states that encourage community solar or other shared renewables.
- 24,193 sites screened positively for distributed generation (DG) in states that have DG policies.
- 133,890 sites screen positively for off-grid solar and could be used on-site to reduce energy use or power green remediation.
- 520 sites screened positively for large scale utility wind in state with tax incentives.
- 2,261 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, are near population centers and cover larger areas with minimal grade. Most municipalities have landfills and the land costs are typically lower when compared to open spaces. The RE-Powering Mapper includes 3,871 landfills that have screened positively for solar.

As of 2018, the RE-Powering Initiative has identified 165 completed solar on landfill projects generating 446 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.

Mapper Resources

RE-Powering Screening Datasets

The datasets underlying the Mapper can be exported from the tool or downloaded directly in Microsoft Excel format from the Mapper landing page.

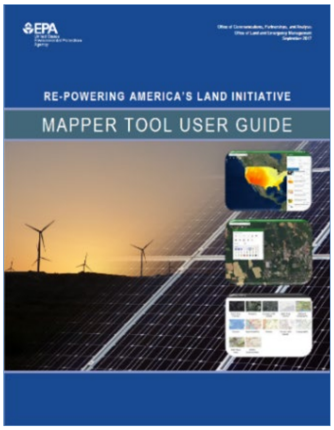
Data Documentation

The Data Documentation for Mapping and Screening describes the data sources, screening methodology and screening criteria in detail.

Mapper User Guide and Quick-Start Guide

The Mapper User Guide is a step-by-step guide for accesssing and visualizing the data contained in the RE-Powering Mapper.

The Quick-Start Guide is a one-page guide to help users quickly gain an understanding of how to use the RE-Powering Mapper.



SUPERFUND	BROWNFIELDS	RCRA	AML	LMOP	STATE TRACKED
2,069 sites	28,243 sites	3,769 sites	261 sites	2,098 sites	97,575 sites
11,099,262 acres	1,273,635 acres	17,840,124 acres	1,395 acres	211,316 acres	14,064,702 acres
178,705 MW capacity	102,625 MW capacity	283,845 MW capacity	310 MW capacity	47,660 MW capacity	737,633 MW capacity

Solar Technologies

What is Solar Energy?

Solar technologies generate electricity from the sun's energy. The following types of solar production technologies were evaluated:

- ***Photovoltaic (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. Five scales of solar PV energy were evaluated:
- ***Large Utility Scale PV Solar*** - Uses PV technology at the 100 megawatt (MW) scale at sites with the greatest resource and acreage availability. Electricity generated is typically exported to the grid.
- **Utility Scale PV Solar** - Uses PV technology at the 50 to 100 MW scale at sites with the greatest resource and acreage availability. Electricity generated is typically exported to the grid.
- **Small Utility Scale PV Solar** - Uses PV technology at the 2 to 50 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.
- ***Large Distributed Scale PV Solar***- Uses PV technology at the 10-killowatt (kW) scale or greater at sites with strong resource and suitable acreage availability. Electricity generated is typically used to offset onsite electricity consumption.
- ***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).

Solar Results by Technology

Screening Results	All Sites		
	Sites	*Acres*	*Est. Capacity (MW)*
Large Utility Scale PV	1,779	41,334,349	632,546
Utility Scale PV	1,328	501,552	11,456
Small Utility Scale PV	24,355	1,299,067	288,697
Large Distributed Scale PV	89,713	41,665,934	980,464
Off-grid PV	133,890	43,933,587	NA

What are some examples of solar facilities being successfully sited on contaminated land?

RE-Powering America's Land Initiative tracks the installation of renewable energy projects on contaminated lands, landfills, and mine sites. For example, a 7-MW solar PV array was installed 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 will avoid 6,000 tons of CO2 and provide electricity sufficient to power 1,200 homes annually.

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.

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:

- ***Large Utility Scale Wind*** – Uses wind technology at the 100 megawatt (MW) scale at sites with the greatest resource and acreage availability. Electricity generated is typically exported to the grid.
- ***Utility Scale Wind*** – Uses wind technology at the 50 to 100 MW scale at sites with the greatest resource and acreage availability. Electricity generated is typically exported to the grid.
- ***Small Utility Scale Wind*** – Uses wind technology at the 2 to 50 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.
- ***Large Distributed Scale Wind*** –Uses PV technology at the 10-killowatt (kW) scale or greater at sites with strong resource and suitable acreage availability. Electricity generated is typically used to offset onsite electricity consumption.
- ***1-2 Turbine Scale***– Represents 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.
- ***Off-grid Wind***– Uses smaller and fewer turbines on a much smaller scale, typically to power the energy needs of a single property when interconnection to the grid may not be feasible.

Steel Winds, Lackawanna, NY

What are some examples of wind facilities being successfully sited 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 Resource Conservation and Recovery Act, or 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.

Wind Results by Technology

Screening Results	All Sites		
	Sites	*Acres*	*Est. Capacity (MW)*
Large Utility Scale Wind	580	36,355,266	159,348
Utility Scale Wind	361	296,792	10,177
Small Utility Scale Wind	3,174	708,047	47,598
Large Distributed Scale Wind	19,709	38,035,436	311,650
1-2 Turbine Scale	29,767	36,175,592	316,261
Off-grid Wind	39,520	35,980,653	NA

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 for the production of electric power, heat, chemicals or fuels.

Three 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 utilize 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 utilizes cumulative herbaceous sources such as crop residues.
- ***Landfill gas energy project*** – Uses gas from decomposing organic municipal solid waste. This gas consists mostly of methane (the primary component of natural gas) and carbon dioxide. Instead of allowing landfill gas to escape into the air, it is extracted from landfills using a series of wells and a blower/flare (or vacuum) system. The extracted landfill gas is directed to a central point where it can be processed and treated to produce various forms of energy, including electricity, boiler fuel, steam, alternate vehicle fuel, and pipeline quality gas.

Biomass Results by Technology

Screening Results	All Sites		
	Sites	*Acres*	*Est. Capacity (MW)*
Biopower Facility	36,967	30,120,010	369,670
Biofuels facility	2,261	16,150,431	45,220
Landfill gas energy project	539	99,065	NA

The McNeil Station biopower facility in Burlington, VT

What are some examples of biomass facilities being successfully sited 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 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.

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, in that 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

Screening Results	All Sites		
	Sites	*Acres*	*Est. Capacity (MW)*
Geothermal Heat Pump	110,593	40,808,223	NA

Tech Town Campus. Photo courtesy of City Wide Development.

What are some examples of geothermal facilities being successfully sited 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, as well as 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.