RE-Powering America's Land:
Siting Renewable Energy on Potentially Contaminated Land and Mine Sites

Solar Technologies

What is the *RE-Powering America's Land* initiative?

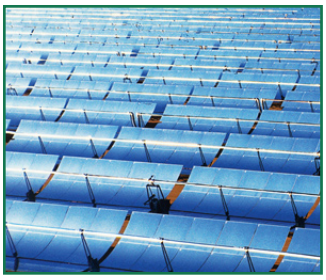
Demand for renewable energy is increasing in the United States. However, renewable energy facilities often require large amounts of land and could contribute to energy sprawl if developed on greenfield sites. Through its *RE-Powering America's Land: Siting Renewable Energy on Potentially Contaminated Land and Mine Sites* initiative, the U.S. Environmental Protection Agency (EPA) identified more than 11,000 EPA tracked sites and nearly 15 million acres that have potential for developing solar, wind, biomass and geothermal facilities. Using potentially contaminated land and mine sites to develop renewable energy facilities can preserve greenfields; provide developers with access to existing infrastructure; create jobs; and enable potentially contaminated property to return to a productive and sustainable use.

What is solar energy?

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

Utility scale concentrating solar power (CSP) – Uses the sun's thermal energy to heat a liquid that drives a generator to produce electricity. CSP technology is constructed at the megawatt (MW) or multi-MW scale and electricity generated is typically exported to the grid. Three types of utility scale CSP technologies were evaluated by EPA:

- ***Trough system*** – Uses long rectangular, curved (U-shaped) mirrors that concentrate sunlight on tubes that run the length of the mirrors. A fluid heated inside the tubes boils water for a conventional steam-turbine generator to produce electricity.
- ***Power tower system*** – Uses a large field of flat, sun-tracking mirrors known as heliostats to concentrate sunlight onto a receiver on top of a tower. A fluid heated in the receiver generates steam for a conventional steam-turbine generator to produce electricity.
- ***Stirling engine system*** – Uses a mirrored dish to concentrate sunlight onto a thermal receiver. A fluid heated inside the receiver moves pistons and creates mechanical power, which runs the Stirling engine to produce electricity.



A CSP trough system

The Solar Two CSP power tower system near Barstow, CA

A CSP Stirling engine system in Boulder, CO

How much solar potential exists on contaminated sites?

Utility scale concentrating solar power (CSP)
Trough and power tower systems – *60 sites*
Stirling engine system – *85 sites*

Direct normal solar resource availability ≥ 6 kWh/m2/day
Distance to transmission lines ≤ 10 miles
Acreage (trough and power tower systems) ≥ 250 acres
Acreage (Stirling engine system) ≥ 40 acres
Distance to graded roads ≤ 25 miles

Utility scale photovoltaic (PV) – *470 sites*

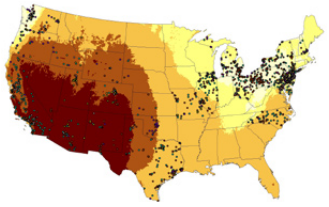
Direct normal solar resource availability ≥ 5 kWh/m2/day
Distance to transmission lines ≤ 10 miles
Acreage ≥ 40 acres
Distance to graded roads ≤ 25 miles

PV policy driven – *1,355 sites*

This category only includes sites in states with an RPS solar set-aside, solar multiplier or distributed generation incentive. The criteria are the same as utility scale PV, except that resource availability is not considered.

Non-grid connected PV – *11,384 sites*

There are no formal screening criteria as PV technology can be sited at all properties.



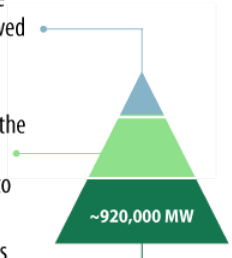
Estimating total technical potential

Solar technical potential for EPA tracked sites: almost 920,000 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.



EPA

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. Three types of PV production were evaluated by EPA:

- ***Utility scale PV*** – Uses PV technology at the MW or multi-MW scale at sites with the greatest resource and acreage availability. Electricity generated is typically exported to the grid.
- ***PV policy driven*** – Represents sites that may have development potential due to state policies, including sites in areas with lower resource availability. One of the most important state policies affecting the development of electricity from solar energy is a renewable portfolio standard (RPS) that includes a solar set-aside, which requires a certain percentage of the state's electricity be generated from solar resources. An RPS can also include a solar multiplier that gives additional credit for solar projects that contribute toward meeting the RPS, or a requirement for distributed generation (i.e., electricity generation close to the point of use). Most states allow electric power providers to meet RPS solar requirements by purchasing solar renewable energy certificates from non-utility producers. These incentives may help to make PV projects financially viable in areas with lower solar resource availability.

A PV array at Fort Carson, CO

- ***Non-grid connected PV*** – Uses PV technology at a smaller scale, typically to power the energy needs of a single property.

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

The *RE-Powering America's Land* Web site highlights several solar facilities developed on contaminated land. At the Fort Carson Army Base in El Paso County, Colorado and the Nellis Air Force Base near Las Vegas, Nevada, solar panels were mounted on former Resource Conservation and Recovery Act (RCRA) landfills to provide power to base facilities. Fort Carson's 2 MW PV solar array generates 3,200 MW-hours of power annually. This is enough to supply 2.3% of Fort Carson's energy consumption, which is the equivalent of 540 homes. Nellis' 14 MW PV system is estimated to generate at least 25 million kilowatt-hours annually. This is enough to power 2,350 homes and save $1 million on electricity and 24,000 tons of carbon dioxide annually. In Richmond, California, a 1MW solar PV system was developed partially on a site that was previously used as a sludge-drying pond and is now used for storm water management; it provides 30% of the wastewater treatment facility's electricity needs.

PV roof panels in Pemaco, CA

There are several cases in which PV solar facilities have been used to power ground water remediation on Superfund sites, such as the Frontier Fertilizer site in Davis, California, the Pemaco site in Maywood, California, the Apache Power site near Benson, Arizona and the Lawrence Livermore National Laboratory near Livermore, California. These solar projects provide significant energy cost savings and, in some cases, support ground water treatment in remote areas that would otherwise require the installation of costly power lines or generators.