

Brisbane Baylands Solar Feasibility Study

EPA-NREL RE-Powering Feasibility Studies



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Hosted by R9 SFD & OSWER CPA

RE-Powering Brisbane

- EPA's RE-Powering America's Land Initiative
- EPA-NREL Solar Feasibility Studies
- Solar Feasibility Findings for Brisbane Baylands
  - Positive technical and economic feasibility for utility-scale (>20 MW) solar PV
  - Scenarios assessed reflect development scenarios with mixes of ground-mount and rooftop solar systems
- Additional tools & resources

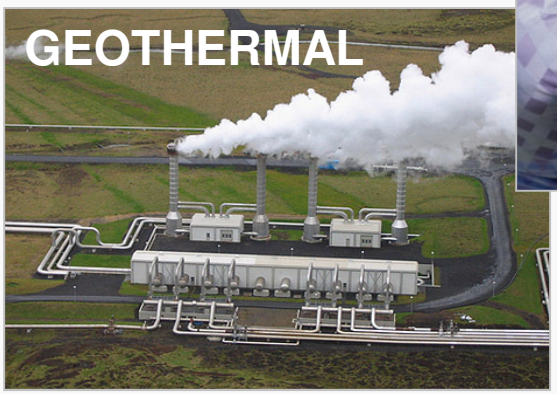
RE-Powering America's Land

EPA's RE-Powering America's Land Initiative encourages renewable energy development on current and formerly contaminated land, landfills and mine sites when aligned with the community's vision for the site.



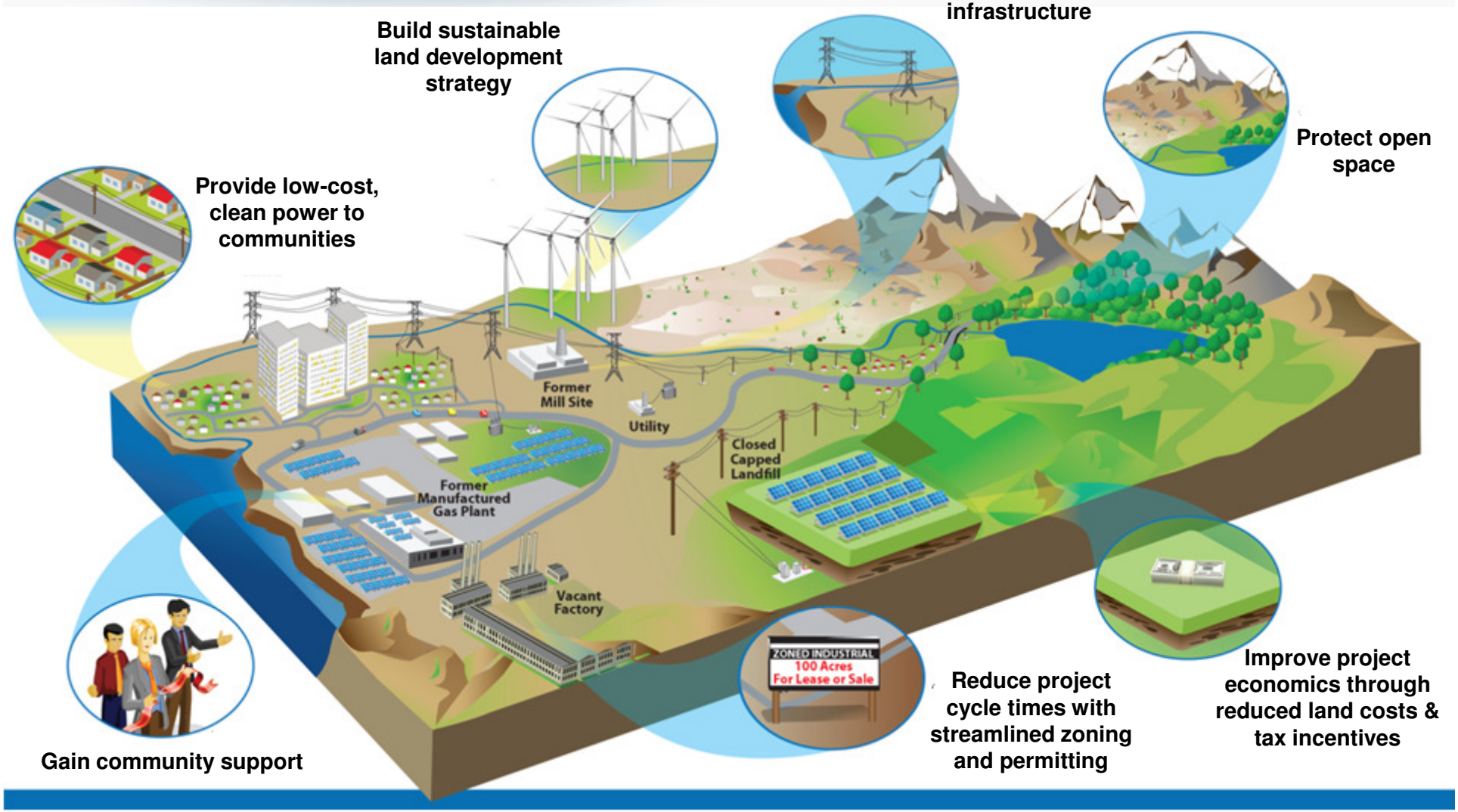








Benefits of Redeveloping Potentially Contaminated or Underutilized Sites



ENIVIRONMENTAL PROTECTION AGENCY PA-NATIONAL RENEWABLE ENERGY LAB FEASIBILITY STUDIES

Study Objectives & Scope

Objective

- Evaluate technical and economic potential of selected contaminated sites and landfills by leveraging EPA-NREL's renewable energy expertise
- Provide site owners and stakeholders with a third-party assessment of technical and economic feasibility of development potential

Scope

Analysis takes into account:

- Renewable energy resource;
- Available acreage;
- Distance to utility and transportation infrastructure;
- Electricity use onsite (current & planned);
- Local energy market; and
- Potential ownership structures.

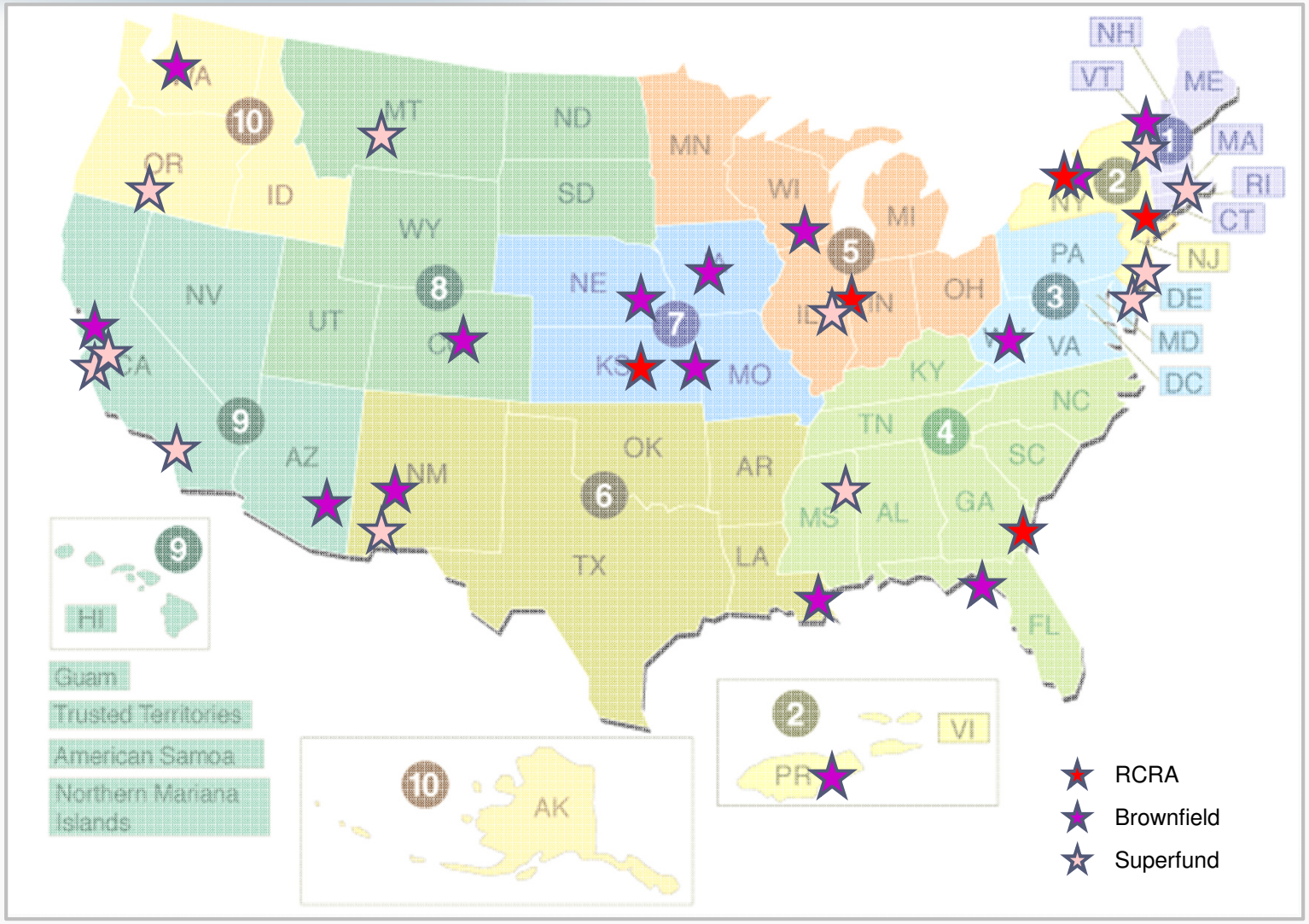
Does not include:

- Environmental assessment;
- Interconnection study;

Output

- Overall assessment of technical feasibility for installing renewables at a given site
- Performance and economic analysis across multiple system configurations and ownership structures

EPA-NREL Feasibility Study Sites



EPA-NREL Feasibility Study Summary

BRISBANE BAYLANDS

Brisbane Baylands Site

Case Studies



Developer Option



Renewable Alternative

Proposed Options	System Type	Acreage *(acres)*	Solar Capacity Potential *(MW)*
Developer *As proposed by UPC*	Ground Mount	24.7	3.5 – 4.3 MW**
	Rooftop	274.1	23.9 MW
Renewable Energy Alternative *As proposed by CREBL*	Ground Mount	134.2	19.3 – 23.4 MW**
	Rooftop	60.7	4 MW

* For rooftop applications, assuming 50% of total area usable for rooftop PV

** Range due to scenarios using either single-axis tracking systems or fixed tilt mounting systems.

Solar Energy Potential

Under both scenarios

> **20 MW** solar energy potential

> **40 million kilowatt-hours** per year of estimated annual energy output

> **7,000 homes** powered

~ **700 jobs** created during construction

> **7 jobs** sustained during operation

Primary Differences

- Location of solar & development timeline

Scenario Comparison

Performance Analysis Details

System Type	PV System Size[a] (kW)	Array Tilt (deg)	Annual Output (kWh/year)	Number of Houses Powered[b]	Jobs Created[c] (job-year)	Jobs Sustained[d] (job-year)
Renewable Energy Alternative Rooftop PV System	4,000	20	6,018,006	1,056	101	1
Renewable Energy Alternative Fixed Axis Ground Mounted System	23,380	20	35,175,244	6,171	590	7
Crystalline Silicon (Fixed-Axis Ground System) - Renewable Energy Alternative, Developer Owned	27,380	20	41,193,250	7,227	691	8
Renewable Energy Alternative Rooftop PV System	4,000	20	6,018,006	1,056	101	1
Renewable Energy Alternative 1-Axis Ground Mounted System	19,281	20	37,007,662	6,493	649	6
Crystalline Silicon (1-Axis Ground System) - Renewable Energy Alternative, Developer Owned	23,281	20	43,025,668	7,548	750	7
Developer Rooftop PV System	23,876	20	35,921,477	6,302	603	7
Developer Fixed Axis Ground Mounted System	4,303	20	6,473,870	1,136	109	1
Crystalline Silicon (Fixed-Axis Ground System) - Developer Option, Developer Owned	28,179	20	42,395,347	7,438	711	9
Developer Rooftop PV System	23,876	20	35,921,477	6,302	603	7
Developer 1-Axis Ground Mounted System	3,548	20	6,809,978	1,195	119	1
Crystalline Silicon (1-Axis Ground System) - Developer Option, Developer Owned	27,424	20	42,731,455	7,497	722	8

Scenario Comparison

Economic Analysis Details

System Type	System Cost	Maximum Incentive Amount	PPA Price ¢/kWh	Net Present Value 2012$	Annual O&M ($/year)	Payback Period with Incentives (years)
Renewable Energy Alternative Rooftop PV System	$ 13,690,000	$ 4,840,444	13.25	$ 169,556	$ 108,889	13.89
Renewable Energy Alternative Fixed Axis Ground Mounted System	$ 75,066,000	$ 26,806,783	13.06	$ 1,375,151	$ 636,453	13.69
Crystalline Silicon (Fixed-Axis Ground System) - Renewable Energy Alternative, Developer Owned	$ 88,756,000	$ 31,647,227	13.09	$ 1,544,707	$ 745,342	13.72
Renewable Energy Alternative Rooftop PV System	$ 13,690,000	$ 4,840,444	13.25	$ 169,556	$ 109,749	13.89
Renewable Energy Alternative 1-Axis Ground Mounted System	$ 77,990,992	$ 27,907,606	11.92	$ 3,942,864	$ 529,019	12.43
Crystalline Silicon (1-Axis Ground System) - Renewable Energy Alternative, Developer Owned	$ 91,680,992	$ 32,748,051	12.11	$ 4,112,420	$ 638,768	12.68
Developer Rooftop PV System	$ 80,473,360	$ 28,519,938	13.05	$ 1,406,007	$ 620,776	13.69
Developer Fixed Axis Ground Mounted System	$ 14,708,080	$ 5,201,427	13.23	$ 188,405	$ 111,878	13.87
Crystalline Silicon (Fixed-Axis Ground System) - Developer Option, Developer Owned	$ 95,181,440	$ 33,721,365	13.08	$ 1,594,412	$ 732,654	13.72
Developer Rooftop PV System	$ 80,473,360	$ 28,519,938	13.05	$ 1,406,007	$ 620,776	13.69
Developer 1-Axis Ground Mounted System	$ 14,555,536	$ 5,196,627	12.09	$ 660,859	$ 92,248	12.60
Crystalline Silicon (1-Axis Ground System) - Developer Option, Developer Owned	$ 95,028,896	$ 33,716,565	12.90	$ 2,066,866	$ 713,024	13.55

a Data assume a maximum usable area of 684 acres

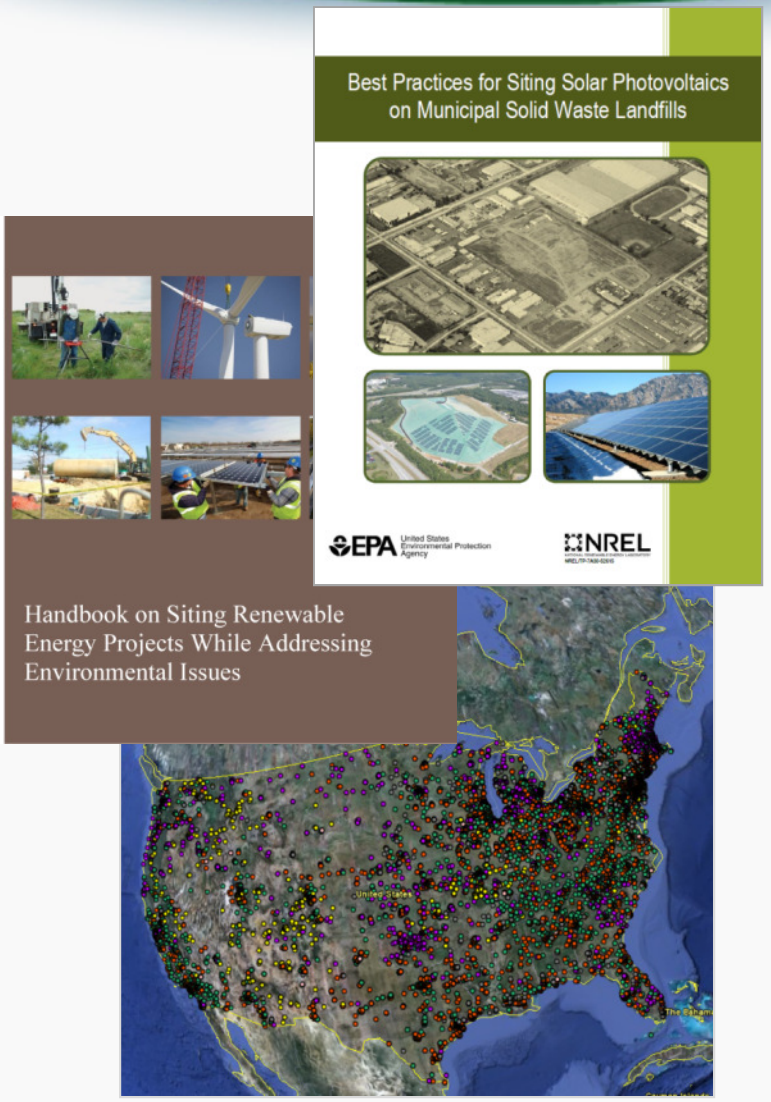
b Number of average American households that could hypothetically be powered by the PV system assuming 5,700 kWh/year/household.

c Job-years created as a result of project capital investment including direct, indirect, and induced jobs.

d Jobs (direct, indirect, and induced) sustained as a result of operations and maintenance (O&M) of the system.

RE-POWERING TOOLS & RESOURCES

Guidance for Renewables on Contaminated Lands & More



Handbook on Siting Renewable Energy Projects While Addressing Environmental Issues

Opportunities for siting renewable energy projects while addressing environmental site issues during all phases of cleanup

Best Practices for Siting Solar PV on Landfills

Current best practices unique to siting solar systems on landfills associated with system design, construction, O&M

Other tools & resources

- EPA-NREL feasibility studies
- Liability factsheets
- Success stories & case studies
- Quarterly webinars & newsletters
- Topic-specific workshops

RE-Powering Contacts & Resources

RE-Powering America's Land Initiative

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Installed projects & trends

R9 & NATIONAL SNAPSHOT

RE-Powering America's Land

R9 installations to date

2 of 14 MW installed on capped landfill



NV: Nellis AFB

Solar array powering remediation at Superfund site



CA: Frontier Fertilizer

Solar powering remediation



CA: Pemaco

Solar array installed on capped landfill at Marine Corps base



CA: Camp Pendleton

Dual-axis trackers installed at wastewater treatment plant



CA: West County Wastewater Treatment District

Solar array installed on remediated industrial site



HI: Kapolei Sustainable Energy Park

Solar array installed on remediated industrial site



CA: Aerojet Superfund Site

Trackers installed at remediated SF site



CA: Fischer Depot Park

RE-Powering America's Land

Nationwide

Wind turbines installed during remediation at abandoned steel mill



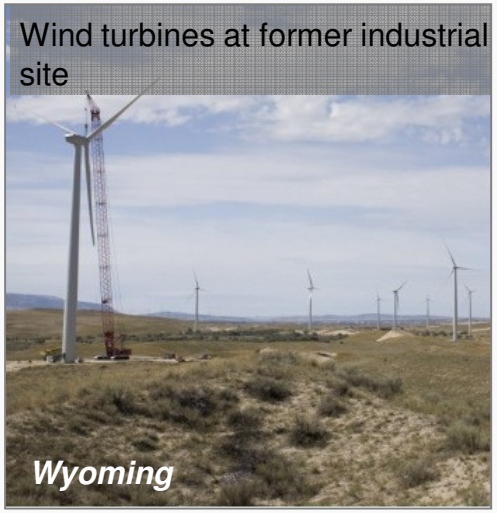
New York

Concentrators installed on remediated mine tailings



New Mexico

Wind turbines at former industrial site



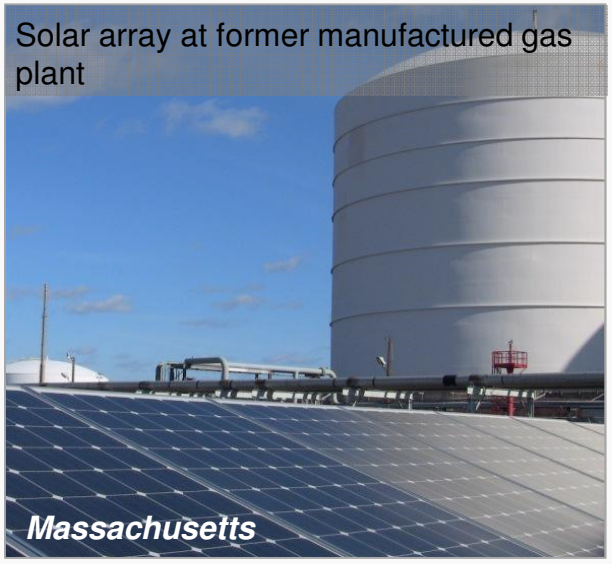
Wyoming

Solar array installed on landfill cap



Colorado

Solar array at former manufactured gas plant



Massachusetts

Solar array at former foundry



Illinois

Solar geomembrane capping landfill



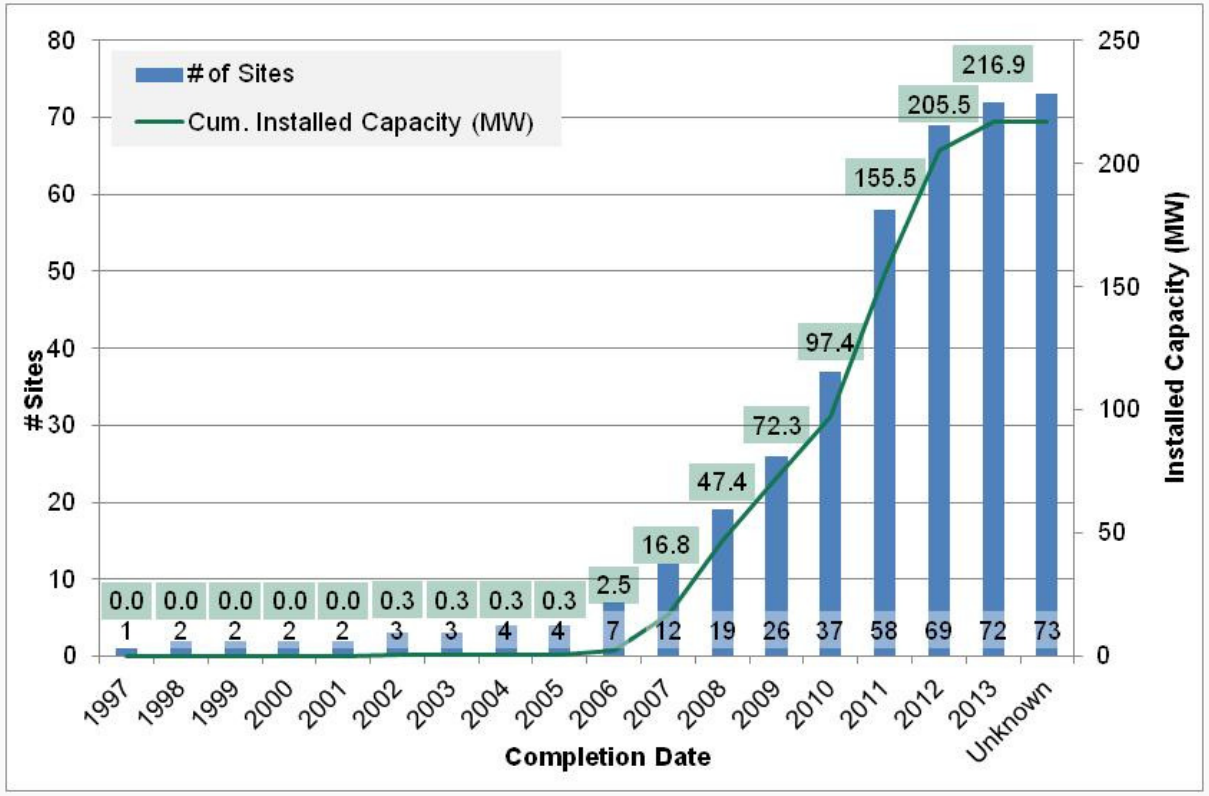
Georgia

Solar array at Superfund site



California

Project Tracking



RE-Powering Installations

	# Sites	Installed Capacity (MW)
NY	6	67.2
NJ	10	22.7
MA	16	21.4
SC	1	20.0
WY	2	19.8
NV	1	14.2
CA	8	12.1
IL	2	10.9
TN	2	9.7
CO	5	5.9
RoUS	20	13.0
	73	216.9

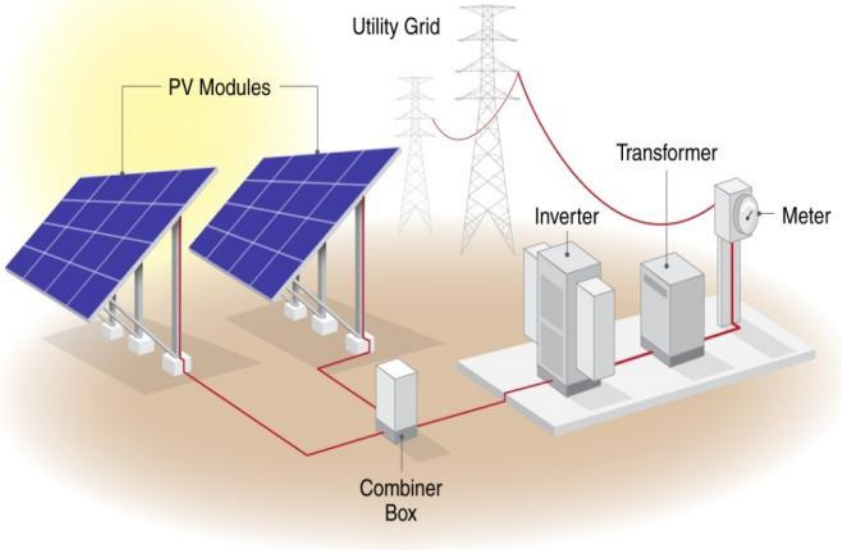
PV System Components



Cells



Modules or Panels



Systems

Solar PV Installation

PV Cell / Module Technologies

Crystalline silicon modules on horizontal, single-axis tracking system



Crystalline Silicon

- Material: Silicon (Si)
- Module efficiency: 12-20%
- Optimal radiation: Direct
- Market share: 80-90%

Thin film on fixed tilt mounting system



Thin Film

- Materials: Amorphous silicon (a-Si), Cadmium Telluride (CdTe), Copper Indium Gallium diSelenide (CIGS)
- Module efficiency: 6-12%
- Optimal radiation: Diffuse
- Market share: 10-20%

PV Mounting Systems

Fixed tilt system at landfill



Horizontal, single-axis tracking system at former brownfield site



Tilted single-axis tracking system at Nellis AFB landfill



Fixed Tilt

Panels mounted on rigid mounting structure

- Energy production: Lower than tracking
- Land use: High packing density
- O&M: No moving parts

Tracking

Panels mounted in either a horizontal or tilted orientation on rotating mounting structure that tracks the sun east to west

- Energy production: Higher relative to fixed
- Land use: May require increased spacing between mounting structures
- O&M: Motors, bearings, and other moving structural members

Foundation Options

Fixed tilt system with ballasted foundations on gravel at landfill



Massachusetts

Pre-cast ballast foundations



Solar array installed on shallow pour foundations at Ft. Carson landfill



Colorado

Minimally penetrating slab foundation



Colorado