

= Solar power plants in the Mojave Desert =

There are several solar power plants in the Mojave Desert which supply power to the electricity grid . Insolation (solar radiation) in the Mojave Desert is among the best available in the United States , and some significant population centers are located in the area . These plants can generally be built in a few years because solar plants are built almost entirely with modular , readily available materials . Solar Energy Generating Systems (SEGS) is the name given to nine solar power plants in the Mojave Desert which were built in the 1980s , the first commercial solar plant . These plants have a combined capacity of 354 megawatts (MW) which made them the largest solar power installation in the world , until Ivanpah Solar Power Facility was finished in 2014 .

Nevada Solar One is a solar thermal plant with a 64 MW generating capacity , located near Boulder City , Nevada . The Copper Mountain Solar Facility is a 150 MW photovoltaic power plant in Boulder City , Nevada . The Ivanpah Solar Power Facility is a 370 MW facility which consists of three separate solar thermal power plants just off interstate highway 15 on the Nevada @-@ California border in the Mojave Desert . There are also plans to build other large solar plants in the Mojave Desert .

= = Overview = =

The southwestern United States is one of the world 's best areas for insolation , and the Mojave Desert receives up to twice the sunlight received in other regions of the country . This abundance of solar energy makes solar power plants a cleaner alternative to traditional power plants , which burn fossil fuels such as oil and coal . Solar power stations provide an environmentally benign source of energy , produce virtually no emissions , and consume no fuel other than sunlight . Some groups are also encouraging more distributed generation , or rooftop solar .

In 2008 , solar electricity was not cost competitive with bulk , baseload power . However , it does provide electricity when and where power is most limited and most expensive , which is a strategic contribution . Solar electricity mitigates the risk of fuel @-@ price volatility and improves grid reliability . Since then costs have decreased to make solar electricity increasingly competitive .

While many of the costs of fossil fuels are well known , others (pollution related health problems , environmental degradation , the impact on national security from relying on foreign energy sources) are indirect and difficult to calculate . These are traditionally external to the pricing system , and are thus often referred to as externalities . A corrective pricing mechanism , such as a carbon tax , could lead to renewable energy , such as solar thermal power , becoming cheaper to the consumer than fossil fuel based energy .

Solar thermal power plants can generally be built in a few years because solar plants are built almost entirely with modular , readily available materials . In contrast , many types of conventional power projects , especially coal and nuclear plants , require long lead times .

= = Solar plants = =

= = = Solar One and Solar Two = = =

Solar power towers use thousands of individual sun @-@ tracking mirrors (called heliostats) to reflect solar energy onto a central receiver located on top of a tall tower . The receiver collects the sun 's heat in a heat @-@ transfer fluid that flows through the receiver . The U.S. Department of Energy , with a consortium of utilities and industry , built the first two large @-@ scale , demonstration solar power towers in the desert near Barstow , California .

Solar One operated successfully from 1982 to 1988 , proving that solar power towers work efficiently to produce utility @-@ scale power from sunlight . The Solar One plant used water / steam as the heat @-@ transfer fluid in the receiver ; this presented several problems in terms of storage and continuous turbine operation . To address these problems , Solar One was upgraded to

Solar Two , which operated from 1996 to 1999 . Both systems had a 10 MW power capacity .

The unique feature of Solar Two was its use of molten salt to capture and store the sun 's heat . The very hot salt was stored and used when needed to produce steam to drive a turbine / generator that produces electricity . The system operated smoothly through intermittent clouds and continued generating electricity long into the night . Solar Two was decommissioned in 1999 , and was converted by the University of California , Davis , into an Air Cherenkov Telescope in 2001 , measuring gamma rays hitting the atmosphere .

== Solar Energy Generating Systems ==

Trough systems predominate among today 's commercial solar power plants . Nine separate trough power plants , called Solar Energy Generating Systems (SEGS) , were built in the 1980s in the Mojave Desert near Barstow by the Israeli company BrightSource Energy (formerly Luz Industries) . These plants have a combined capacity of 354 MW . NextEra says that the solar plants power 232 @, @ 500 homes (during the day , at peak power) and displace 3 @, @ 800 tons of pollution per year that would have been produced if the electricity had been provided by fossil fuels , such as oil .

Trough systems convert the heat from the sun into electricity . Because of their parabolic shape , trough collectors can focus the sun at 30 @-@ 60 times its normal intensity on a receiver pipe located along the focal line of the trough . Synthetic oil circulates through the pipe and captures this heat , reaching temperatures of 390 ° C (735 ° F) . The hot oil is pumped to a generating station and routed through a heat exchanger to produce steam . Finally , electricity is produced in a conventional steam turbine . The SEGS plants operate on natural gas on cloudy days or after dark , and natural gas provides 25 % of the total output .

== Desert Sunlight Solar Farm ==

The Desert Sunlight Solar Farm is a 550 megawatt (MWAC) photovoltaic power station approximately six miles north of Desert Center , California , in the Mojave Desert . It uses approximately 8 @. @ 8 million cadmium telluride modules made by the US thin @-@ film manufacturer First Solar . As of Fall 2015 , the Solar Farm has the same 550 MW installed capacity as the Topaz Solar Farm in the Carrizo Plain region of Central California , making both of them tied for the second largest completed solar plants by installed capacity .

== Nevada Solar One ==

Nevada Solar One has a 64 @-@ MW generating capacity and is located in Boulder City , Nevada . It was built by the U.S. Department of Energy , National Renewable Energy Laboratory , and Acciona Solar .

Nevada Solar One uses parabolic troughs as thermal solar concentrators , heating tubes of liquid which act as solar receivers . These solar receivers are specially coated tubes made of glass and steel , and about 19 @, @ 300 of these four meter long tubes are used in the plant . Nevada Solar One also uses a technology that collects extra heat by putting it into phase @-@ changing molten salts , which enable energy to be drawn at night . Using thermal energy storage systems , solar thermal operating periods can even be extended to meet baseload needs . Solar thermal power plants designed for solar @-@ only generation are well matched to summer noon peak loads in prosperous areas with significant cooling demands , such as the south @-@ western United States .

The cost of Nevada Solar One is in the range of \$ 220 ? 250 million . The power produced is slightly more expensive than wind power , but was less than photovoltaic (PV) power . As photovoltaics became less expensive , some proposed CSP projects have been converted to photovoltaics projects .

== Copper Mountain Solar Facility ==

The Copper Mountain Solar Facility is a 150 megawatt (MW) solar photovoltaic power plant in Boulder City , Nevada . Sempra Generation began construction of the plant in January 2010 and the facility began generating electricity on December 1 , 2010 . At its construction peak more than 350 workers were installing the 775 @, @ 000 First Solar panels on the 380 acre site . The power from Copper Mountain Solar Facility (and the adjacent 10 MW El Dorado Solar Power Plant) is being sold to Pacific Gas & Electric under separate 20 @-@ year contracts . Californian utilities were required to obtain 20 percent of their energy supply from renewable energy sources by the end of 2010 , increasing to 33 percent by 2020 .

= = = Nellis Solar Power Plant = = =

In December 2007 , the U.S. Air Force announced the completion of the Nellis Solar Power Plant , a solar photovoltaic (PV) system , at Nellis Air Force Base in Clark County , Nevada . Occupying 140 acres (57 ha) of land leased from the Air Force at the western edge of the base , this ground @-@ mounted photovoltaic system employs an advanced sun tracking system , designed and deployed by SunPower . Tilted toward the south , each set of solar panels rotates around a central bar to track the sun from east to west . The 14 MW system generates more than 30 million kilowatt @-@ hours of electricity each year (about 82 thousand kilowatt @-@ hours per day) and supply approximately 25 percent of the total power used at the base . The Nellis Solar Power Plant is one of the largest solar photovoltaic systems in North America .

= = = Ivanpah Solar Power Facility = = =

The 392 MW Ivanpah Solar Power Facility , located 40 miles (64 km) southwest of Las Vegas , is the world ? s largest solar @-@ thermal power plant project which became fully operational on February 13 , 2014 . BrightSource Energy received a \$ 1 @. @ 6 billion loan guarantee from the United States Department of Energy to build the project , which deploys 347 @, @ 000 heliostat mirrors focusing solar energy on boilers located on centralized solar power towers . In February 2012 , Ivanpah was awarded the CSP (Concentrating Solar Power) Project of the Year by Solar Power Generation USA .

= = = Mojave Solar Project = = =

The Mojave Solar Project is a solar thermal power facility in the Mojave Desert in California , about 20 miles (32 km) northwest of Barstow . Surrounding the hamlet of Lockhart , Mojave Solar is adjacent to Harper Lake and the SEGS VIII ? IX solar plant . The 250 MW concentrating solar power (CSP) plant was estimated to cost \$ 1 @. @ 6 billion in total and was commissioned in December 2014 . The developer , Abengoa , secured a \$ 1 @. @ 2 billion loan guarantee from the US Department of Energy for the project .

The nominal 250 MW solar electric generating facility generates steam in solar steam generators , which will expand through a steam turbine generator to produce electrical power from twin , independently operable solar fields , each feeding a 125 MW power island . The plant should generate 617 @, @ 000 MWh of power annually , enough power for more than 88 @, @ 000 households and will prevent the emission of over 430 kilotons of CO₂ a year . Pacific Gas & Electric has agreed to a 25 @-@ year power purchase agreement .

= = = Antelope Valley Solar Ranch = = =

The 230 MW Antelope Valley Solar Ranch is a First Solar photovoltaic project now owned by Exelon in the Antelope Valley area of the Western Mojave Desert . In September 2011 , the project received a \$ 646 million loan guarantee from the US Department of Energy , and its construction was estimated to generate 350 construction jobs and 20 permanent jobs . It features an innovative

utility @-@ scale deployment of inverters with voltage regulation and monitoring technologies , which will " enable the project to provide more stable and continuous power " . Electricity from the Antelope Valley Solar Ranch project will be sold to Pacific Gas & Electric Company under a 25 @-@ year contract .

= = Land use issues = =

A 2013 study by the National Renewable Energy Laboratory concluded that the average large photovoltaic plant in the United States occupied 3 @. @ 1 acres of permanently disturbed area and 3 @. @ 4 acres of total site area per gigawatt @-@ hour per year . The average concentrated solar power plant in the US occupied 2 @. @ 7 acres of disturbed area and 3 @. @ 5 acres of total area per GWh / yr , A 2015 life @-@ cycle analysis of land use for various sources of electricity concluded that concentrating solar power had a land @-@ use footprint of 9 @. @ 0 m² / MWhr for trough , and 14 m² / MWhr for power tower . The concentrating solar footprint was smaller than that of coal power (18 m² / MWhr) , but larger than the other sources studied , including ground photovoltaic (7 @. @ 9 m² / MWhr) , natural gas (0 @. @ 49 m² / MWhr) , and wind power (0 @. @ 26 m² / MWhr) .

When considering land use impacts associated with the exploration and extraction through to transportation and conversion of fossil fuels , which are used for most of our electrical power , utility @-@ scale solar power compares as one of the most land @-@ efficient energy resources available :

The federal government has dedicated nearly 2 @, @ 000 times more acreage to oil and gas leases than to solar development . In 2010 the Bureau of Land Management approved nine large @-@ scale solar projects , with a total generating capacity of 3 @, @ 682 megawatts , representing approximately 40 @, @ 000 acres . In contrast , in 2010 , the Bureau of Land Management processed more than 5 @, @ 200 applications gas and oil leases , and issued 1 @, @ 308 leases , for a total of 3 @. @ 2 million acres . Currently , 38 @. @ 2 million acres of onshore public lands and an additional 36 @. @ 9 million acres of offshore exploration in the Gulf of Mexico are under lease for oil and gas development , exploration and production .

Some of the land in the eastern Mojave Desert will be preserved , but the solar industry is mainly interested in areas of the western desert , " where the sun burns hotter and there is easier access to transmission lines " , said Kenn J. Arnecke of FPL Energy , a view shared by many industry executives .

= = Water use issues = =

Concentrating solar plants in the Mojave Desert have brought up issues of water use , because concentrating solar power plants with wet @-@ cooling systems have high water @-@ consumption intensities compared to other types of electric power plants ; only fossil @-@ fuel plants with carbon @-@ capture and storage may have higher water intensities . A 2013 study comparing various sources of electricity found that the median water consumption during operations of concentrating solar power plants with wet cooling was 810 gal / MWhr for power tower plants and 890 gal / MWhr for trough plants . This was higher than the operational water consumption (with cooling towers) for nuclear (720 gal / MWhr) , coal (530 gal / MWhr) , or natural gas (210) . A 2011 study by the National Renewable Energy Laboratory came to similar conclusions : for power plants with cooling towers , water consumption during operations was 865 gal / MWhr for CSP trough , 786 gal / MWhr for CSP tower , 687 gal / MWhr for coal , 672 gal / MWhr for nuclear , and 198 gal / MWhr for natural gas . The Solar Energy Industries Association noted that the Nevada Solar One trough CSP plant consumes 850 gal / MWhr .

In 2007 , the US Congress directed the Department of Energy to report on ways to reduce water consumption by CSP . The subsequent report noted that dry cooling technology was available that , although more expensive to build and operate , could reduce water consumption by CSP by 91 to 95 percent , bringing their consumption below that of conventional power plants . A hybrid wet / dry

cooling system could reduce water consumption by 32 to 58 percent . A 2015 report by NREL noted that of the 24 operating CSP power plants in the US , 17 used wet @-@ cooling systems . The four existing CSP plants with dry @-@ cooled systems were the three power plants at the Ivanpah Solar Power Facility near Barstow , California , and the Genesis Solar Energy Project in Riverside County , California . Of 15 CSP projects under construction or development in the US as of March 2015 , 6 planned to use wet systems (including one wet system using reclaimed wastewater) , 7 planned for dry systems , 1 hybrid , and 1 unspecified .

= = = Birds = = =

Some concentrated solar power plants with power tower designs in the Mojave Desert have come under scrutiny for bird mortality . Birds flying too close to the focal point of the mirrors have been observed bursting into flame in mid @-@ air . Some plant employees called the burning birds " streamers . " The rate of bird deaths at the CSP plants has been a matter of contention . The birds deaths at the Ivanpah Solar Power Facility drew critical media attention in 2014 . The Center for Biological Diversity hired biologist Shawn Smallwood to estimate bird mortality at the Ivanpah plant . In what he called a " back of the napkin " estimate , due to limited data available , Smallwood arrived at 28 @, @ 380 bird deaths per year caused by Ivanpah .