United States Environmental Protection Agency

Renewable Energy Development Opportunities

ASARCO Mission Mine Tailings Area
San Xavier District, Tohono O'odham Nation

Prepared for: Tohono O'odham Nation

U.S. Environmental Protection Agency

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Forward

The U.S. Environmental Protection Agency Abandoned Minelands Team works in partnership with communities to provide technical assistance to explore reuse opportunities at former mine lands. In addition, USEPA's RE-Powering America's Land Initiative identifies Brownfields, Superfund, mining and other contaminated sites for their wind, solar, and biomass development potential and provides technical support and resources for communities, developers, industry, local governments or other stakeholders interested in reusing these sites for renewable energy development.

Front photos from Rummel Engineering and the US Department of Energy

Study Purpose

The purpose of this preliminary study, prepared by the U.S. Environmental Protection Agency (USEPA) for the Tohono O'odham Nation (Nation) is to evaluate the renewable energy development opportunities for a 280-acre portion of the mine tailings area at the ASARCO Mission Mine complex. A portion of the mine complex, including the mine tailings, is located on lands within the San Xavier District of the Tohono O'odham Nation and leased to ASARCO by the Nation for mining related activities. The 280 acres of tailings that are the focus of this study are owned by the Nation, and do not include individually-allotted trust lands.

Introduction

This USEPA study was initiated in response to a September 2010 request from the San Xavier District for technical assistance to explore options for generating solar energy on Nation-owned tailings at the ASARCO site. In December 2010, the Tohono O'odham Legislative Council passed a resolution authorizing the Nation's participation in EPA's assessment of renewable energy options on Nation-owned sections of the tailings areas.

Through the USEPA's Abandoned Mine Land (AML) Team, technical support was offered to the San Xavier District and the Nation. As part of USEPA's interest in encouraging renewable energy development on current and formerly contaminated land and mining sites, this pre-feasibility assessment identifies preliminary opportunities for developing utility-scale renewable energy projects on Nation-owned property within the tailings areas of the ASARCO Mission Mine.

Mine/Tailings Area Background

The ASARCO Mission Mine Complex is a commercial open pit copper mine and underground copper mine. The facility is located near Sahuarita, Arizona (18 miles south of Tucson). The mine site covers approximately 19,000 acres (29 square miles) and includes an open pit 2.5 miles long and 1.5 miles across, associated crushing, grinding and flotation facilities, tailings areas, waste rock dumps, and warehouse and administrative areas. A portion of the mine complex was located on leased lands within the boundaries of the San Xavier District of the Nation. The lands within the District, referred to collectively as "San Xavier Reservation lands," consist of both Nation Trust Lands and individually-allotted Trust Lands.

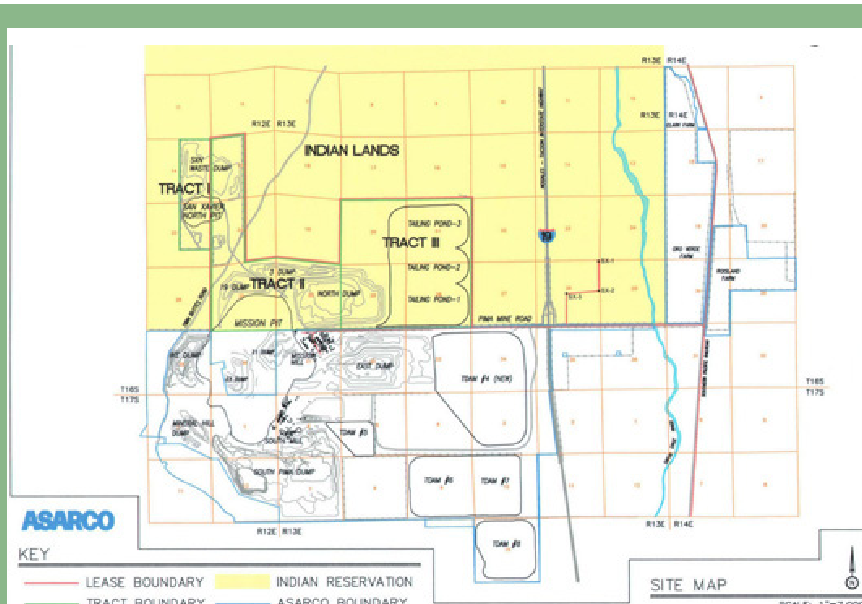


Figure 1: Asarco Mission Mine Area

The mining leases for San Xavier Reservation lands were divided into three tracts depicted in Figure 1. Tract I includes the western half of the San Xavier North Pit and the San Xavier Mine Dump. The Tract I lease was terminated in 2005. Tract II, operating under an active lease, includes the remainder of the San Xavier North Pit and San Xavier Mine Dump, the San Xavier South Pit, and a portion of the North Dump. Tract III includes the east portion of the North Dump and Tailings Areas 1, 2, and 3. The Tract III lease expired in 2009. Renewable energy development opportunities at the site are currently focused on Nation-owned sections of the Tailings Areas in Tract III.

Mine Sections/Areas Identified for Solar Development

Several areas that were formerly used for active mining activities on Nation lands have either been reclaimed or are no longer in use by ASARCO. These areas - in particular the Nation-owned section of the tailings areas in Tract III - have potential for development of utility-scale solar energy projects. The footprint of the tailing areas on San Xavier Reservation lands is approximately 1,400 acres. Of the 1,400 acres, roughly 1,100 acres are flat areas and 300 acres are made up of the tailings embankment. The 280 acres of Nation-owned land identified by the San Xavier District for this pre-feasibility study are part of these tailings areas (Figure 2).

Figure 2: Aerial view (2010 Googleearth aerial image) of Nation-controlled areas on tailings

Site Suitability

The most important requirements for renewable energy projects at a site are the availability of a suitable renewable energy resource, relatively flat land topography, local water availability, and transmission access.

Renewable Energy Resource

Arizona possesses a range of renewable energy resources (wind, biomass, hydro, solar). However, non-solar resources are believed to have limited potential in the state.

Arizona has excellent solar resources statewide and the state is expected to have a unique reliance on solar to meet future renewable energy requirements. The potential solar resource in Arizona is large. Projections suggest upwards of 65 percent of the State's renewable energy demand in 2025 will be met by solar energy.

With over 300 days of sunlight a year and average solar radiation estimated at 6kWh/m2/day, the ASARCO Mine tailings area has excellent solar resources. In addition, transmission access is available near the Nation-owned section of the tailings area, and the tailings areas are sufficiently flat to support the infrastructure of a solar energy project.

Solar Radiation - ASARCO Mission Mine area

The solar radiation that passes through directly to the earth's surface is called Direct Solar Radiation. Altitude, latitude, time of day, time of year and local weather conditions all affect solar radiation levels at a location. Figure 3 illustrates average direct solar radiation on a horizontal surface for the ASARCO Mission Mine area.

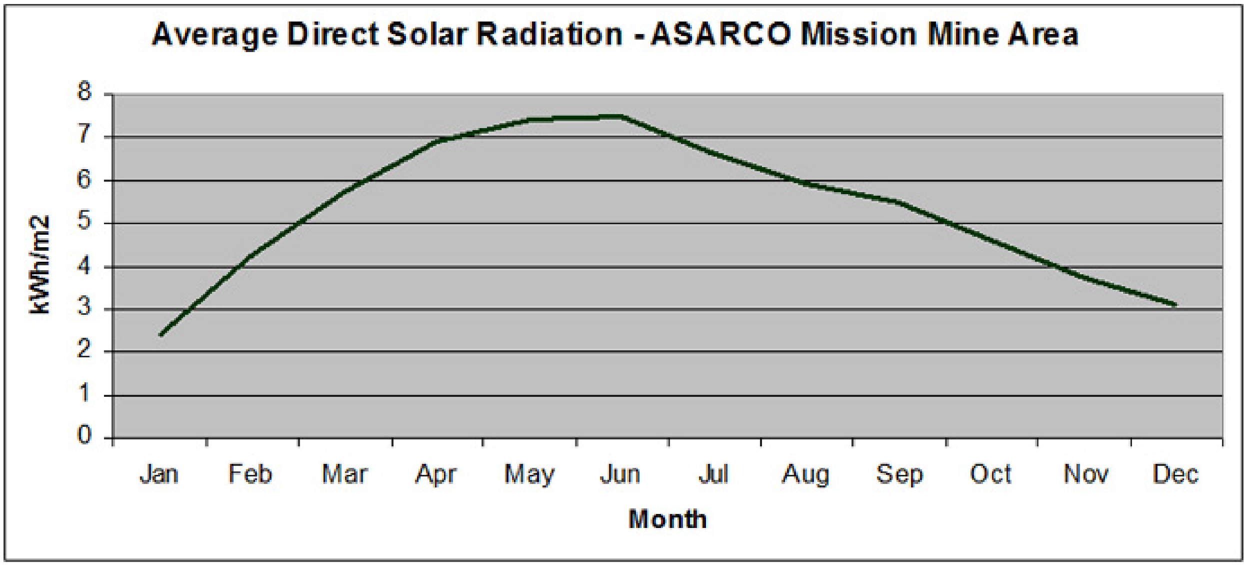


Figure 3: Average Direct Solar Radiation- ASARCO Mission Mine Area (source: NASA Surface Meteorology and Solar Energy Data)

Average direct solar radiation, however, is not the amount of energy produced by a solar energy system. The amount of energy produced by a solar panel depends on several factors, including the type of collector, tilt of the collector, temperature and weather conditions.

Site Infrastructure

There are mining related facilities and structures within the mine area that could support the viability of a utility-scale solar energy project on the San Xavier Reservation lands.

Roads

Tailings access roads encircle Tailing Areas 1, 2, and 3. Any reclamation of roads associated with ASARCO's mining and related operations on Tracts I, II and III is scheduled to occur after the road is no longer necessary for any mining, closure, monitoring or reclamation processes. Some roads may remain un-reclaimed based on discussions with affected allottees.

Buildings

Two blasting supply buildings are located on San Xavier Reservation lands in association with the mining activities. These buildings, which are located to the west of the waste rock area, will either be dismantled and removed or left in place at the direction of affected allottees.

Utilities

Electrical power is supplied to the mine by Tucson Electric Power (TEP). Power lines to the mine include a 13.8 kV (kilovolt) line that is reduced to 4,160 volts for use on site. There are three substations on the mine site itself used by ASARCO as part of day-to-day mining operations. Two utility or cooperative-owned substations are located within 3 miles of the tailings area:

- 345/138 kV South Substation in Sahuarita controlled by Tucson Electric Power; shown in Figure 4; located 1.5 miles east of the tailings area
- 230 kV Sahuarita Substation controlled by Southwest Transmission Cooperative; 3 miles SW of the tailings area

According to TEP, the South Substation in Sahuarita is scheduled to be upgraded and expanded to provide interconnection between a new TEP 345-kV transmission line and the new Gateway Substation west of Nogales. The South Substation will be expanded to add a switching device that will connect to the proposed transmission line. Work by TEP will also include expanding the fence line to allow a second 345-kV circuit to be installed at the South Substation.

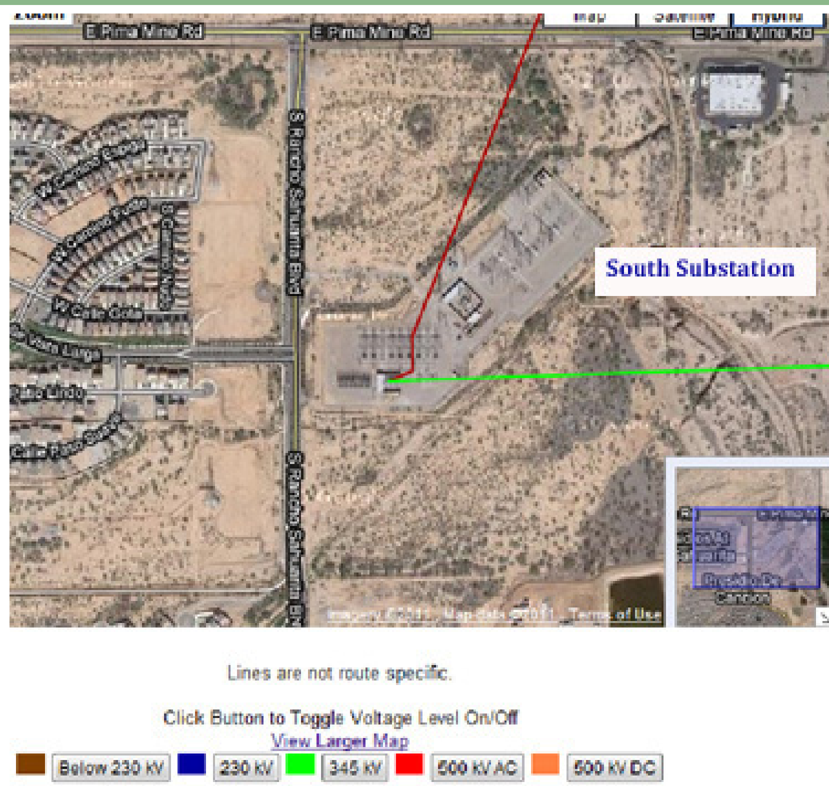


Figure 4: TEP South Substation Aerial

Tailings Topography and Stability

The top of the tailings areas at the Asarco Mine Complex is essentially flat, making it potentially well-suited for a solar project. The tailings area has minimal contouring from the embankment edge toward the centers of Tailings areas 2 and 3 for stormwater management. Tailings Areas 1, 2, and 3 were reclaimed using a two-foot cap and one foot of fill on top of the tailings. Channels and gullies were filled with alluvial and tailings material during reclamation. The slopes of the tailing impoundments were re-graded and a rock armor was added to the embankment for erosion protection. Reclaimed areas were reseeded in 2010 with a seed mix of native perennial species containing a variety of grasses, trees, shrubs, wildflowers and cacti. Once the vegetation is established on top of the tailings, it may need to be managed (i.e. trimmed) to accommodate a solar energy system.

A limited sampling and testing program of the tailings area was completed at the site by Dames and Moore in 1996 as part of the Tailings area 4 (located on ASARCO property) approval process. This work included test borings and piezometer installation (to measure ground water levels) along the face of Tailings Areas 2 and 3. The limited sampling found that the tailings are silty to clayey sands (SM, SC) according to Unified Soil Classification System (USCS). The Dames and Moore report established that the tailings embankment areas would be expected to remain stable, provided that the depth to the phreatic surface (ground water) remains greater than 40 feet. (p. 12) The ASARCO Mine tailings supplement document provides additional information on the nature and extent of technical testing on the tailings areas as well as recommendations for additional testing that could help facilitate a solar energy project on the Nation-owned section of the tailings.

Photovoltaic (PV) Solar System Options

A variety of technologies exist to capture or convert sunlight into useful energy. The two major types of commercially-available solar technologies that were screened for consideration at the mine site were photovoltaic (PV) and concentrating solar power (CSP).

PV systems use solar electric panels to directly convert the sun's energy into electricity. CSP systems generate electricity through the use of mirrors that focus light on a tube of fluid. The focused light superheats the fluid (typically water), and the resulting steam drives turbines, generating electricity. PV systems and CSP systems could both take advantage of the abundant solar resources available on San Xavier Reservation lands. However, each technology has specific requirements that may make it more or less suitable for use at the site.

Table 1: Solar Technology Overview

Solar Technology	Site Requirements	Minimum Cost Effective Plant Size	Water Requirements
PV	Flexible - flat or higher degreed slopes	No minimum size	Minimal - 700-1000 gallons per MW per year
CSP	Large, contiguous, flat area	50MW, possibly > 100MW	Significant - 1.5 to 2 million gallons per MW per year

PV systems are considered to be most suited to the conditions at the 280 acre Nation-owned site. CSP systems typically require large, contiguous land areas, require significant amounts of water, and can store energy. PV systems, in contrast, can be located on smaller land areas, do not require much water and can be cost effective at different project sizes.

The cost of a CSP plant depends on many factors such as plant size, whether thermal energy storage is included, and any site preparation work needed. CSP plants generally need to be large in size to be cost effective to build. The US Department of Energy currently suggests the most cost-effective and economically viable CSP plants are 200-300 MW in size. Because of the significant land needed for a cost effective CSP plant - a 50 MW plant would require 300 or more contiguous acres - and the significant water requirements for CSP, CSP technologies were not considered as viable options for the Nation-owned section of the tailings area.

PV Solar Technologies

PV cells utilize semiconductor technology to convert solar radiation directly into an electric current which can be used immediately or stored for future use. In PV systems, solar cells are often grouped in the form of "modules" or panels that are combined to produce arrays.

PV panels can be silicon-based or made up of solar cells referred to as multi-junction cells (solar cell made of two or more materials).

- Silicon-based PV systems have wide-spread commercial use and typically come in two primary panel options - crystalline and amorphous.
- Multi-junction cells are used in concentrating photovoltaic (CPV) systems, which are an emerging technology that focuses sunlight onto a small area of solar photovoltaic material to then generate electricity.

Crystalline:

There are two types of crystalline panels - mono and poly. Monocrystalline panels are made from a large silicon crystal. Monocrystalline panels are efficient in converting sunlight into electricity; however they are expensive to manufacture and tend to be fragile. Polycrystalline panels are a commonly used type of solar panel. They are less efficient than mono-crystalline solar panels but are also less expensive to produce. This type of panel consists of multiple smaller silicon crystals and look like shattered glass.

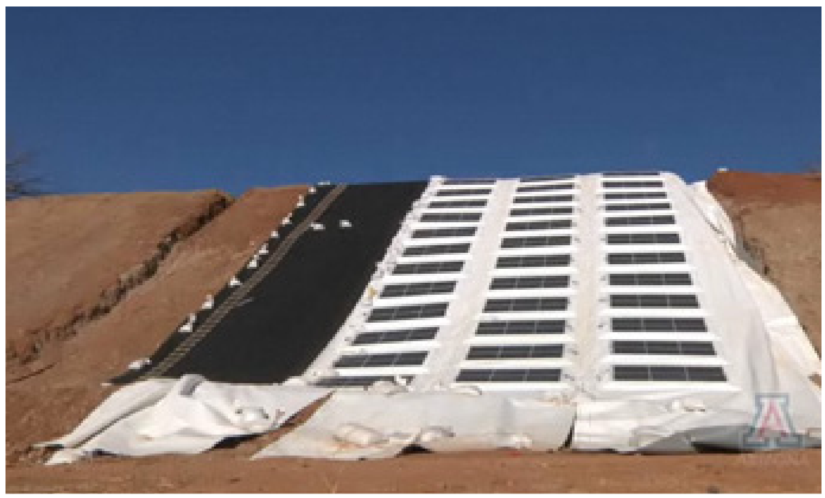
Amorphous or thin film:

The production of thin film panels is different from crystalline panels. Instead of molding, drawing or slicing crystalline silicon, the silicon material in these panels have no crystalline structure and can be applied as a film directly on various materials. These types of solar panels have lower efficiency than crystalline panels and are the cheapest to produce.

As highlighted in the Biosphere 2 example, "thin-film" panels can be attached to geomembrane covers to create an energy-producing cover system that can be used to on hills and other high slope areas.

Flexible PV Laminates at Biosphere 2

In 2010, the Biosphere 2 facility installed 100 solar panels on-site to test the feasibility of placing solar panels in areas where they would minimize their environmental impact without loss in performance.



Source: University of Arizona

The panels have been mounted on a hillside at a 50-degree angle using geomembrane liners. Anchors secure the geomembrane to the hillside and are designed to protect against high wind events and other severe weather conditions.

Concentrated photovoltaics (CPV):

CPV technologies convert light energy into electrical energy in much the same way traditional PV technology does. The difference in the technologies lies in the addition of an optical system that focuses a large area of sunlight onto each cell. CPV systems can "magnify" sunlight on solar cells at varying levels - low, medium, high (HCPV). Because CPV systems act like "telescopes," they only see a small proportion of the sky. As a result, they need to track the sun on at least one axis. A limitation of CPV technologies is that diffuse light, which occurs in cloudy and overcast conditions, cannot be concentrated to created electricity. To reach their maximum efficiency, CPV systems must be located in areas that receive consistent and significant direct sunlight.

PV Solar Technology Costs

A typical solar energy project will vary in cost from $6.00 - $10.00 per installed Watt depending on the size and complexity of system, type of technology, brand and local labor rates. Approximately 60% of that cost is material cost, while the balance of cost is labor, engineering, environmental, permitting and other non PV-system related aspects of a solar project.

The cost information in Table 2 represents installed cost ranges based on the best publicly available industry data. Specific costs will differ depending on the type of solar panels used; local costs; and the individual nature of a solar project installation (i.e., additional costs for site preparation and engineering work). The costs in Table 2 also have not factored in potential state or federal incentives, which could reduce upfront costs by 30 percent.

Table 2: Solar Technology Cost Overview

PV Technology	Installed Costs	O&M Cost	Land Required	Water Demand
PV - Fixed Axis*	$5-7/Watt installed	1-2 c/kWh	5-6 acres / MW	Relatively small - 10,000 gallons per MW per year
PV – Tracking**	$6-9/Watt installed	2-3 c/kWh	7-8 acres / MW	Relatively small - 10,000 gallons per MW per year
PV - Thin Film on a Geomembrane	No public data, proprietary system[1]	Unclear	Will vary	Relatively small - 10,000 gallons per MW per year
High Concentration PV	$7-10/Watt installed	2-3 c/kWh	4-6 acres / MW	Relatively small - 10,000 gallons per MW per year

* Fixed - A fixed system means that the PV panels are installed at a set tilt and azimuth and will not move.
** Tracking - A tracking system is one that moves to track the sun.

Potential PV Solar Energy System Sizes

A portion of the 280-acre Nation-owned tailings area could potentially accommodate a solar energy project given the relatively flat topography and the good south facing aspect of the tailings. There are approximately 150 acres of land on top of the tailings and 80 additional acres on the tailings embankment. Fifty additional acres of Nation-controlled land are located east and south of the tailings areas. Assuming that access roads and other infrastructure will occupy an estimated 20 acres on top of the tailings, approximately 130 acres are available for project development. Figure 5 highlights the Nation-controlled section of Tailings Areas 1 and 2 that could serve as location for a PV project. Yellow areas are on top and off of the tailings and are flat. Brown areas represent the tailings embankment. Figure 5 only takes into account a portion of the entire tailings area.

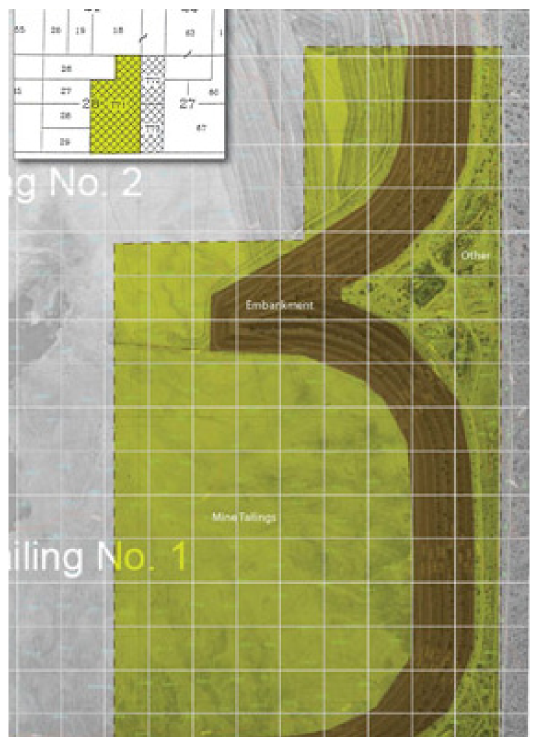


Figure 5: Nation-controlled tailings area

The top of the tailings area would be expected to offer the most suitable location for a solar project. The embankment areas, in particular the South-facing embankment, might offer additional acreage for a PV array but would be expected to require additional engineering considerations to ensure slope stability and to work around rock armoring done during reclamation activities. Without additional geotechnical studies to support such options, the sloped areas are not currently under consideration.

[1] The PV geomembrane system is a new technology, with only a few firms currently manufacturing and installing the technology. As a result, detailed installed cost estimates are not publicly available.

Table 3 illustrates the range of scales at which a utility-scale PV project could be developed on land within the Nation-owned ASARCO Mine tailings area. The Nation-owned section of the tailings could support a solar project between 15 MW to 30 MW in size, assuming an estimated 130 acres are available on top of the tailings. A solar project of this size could cost between $70 and $180 million depending on the selected PV technology and availability of incentives to reduce project costs.

Table 3: Acres with PV potential in Asarco Mission Mine Study Area

Zone	Area	Potential PV-Fixed Array Size	Potential PV-Tracking Size	Potential HC PV Size
1 (top of tailings)	130-150 acres^	20-25 MW	15-20 MW	25-30 MW
2 (embankment)	80 acres	Additional information needed	Additional information needed	Additional information needed

^It is recommended that any PV array provide for a 100-300 foot buffer away from the edge of the tailings embankment to ensure there is no stability impact. As a result, available acreage on top of tailings might be closer to 130 acres.

Based on the acreage estimates in Table 3 and the cost ranges in Table 2, PV system costs are summarized below. These would be potential costs to a project developer or project owner.

- Fixed PV array
  - A fixed PV array 20 MW in size could be expected to cost between $100 and $140M depending on the specific technology used..
  - If the 30% Federal Tax credit is taken into account, a fixed PV array 20 MW in size could be expected to cost between $70 and $100M
- Tracking PV array
  - A tracking PV array 20 MW in size could be expected to cost between $120 and $160M depending on the specific technology used.
  - If the 30% Federal Tax credit is taken into account, a tracking PV array 20 MW in size could be expected to cost between $85 and $115M
- HCPV array
  - An HCPV array 20 MW in size could be expected to cost between $140 and $180M depending on the specific technology used.
  - If the 30% Federal Tax credit is taken into account, a HCPV array 20 MW in size could be expected to cost between $100 and $125M

Potential PV array output

Figure 5 illustrates the estimated monthly energy production from a 20 MW PV solar array. The potential array performance for the fixed and tracking arrays was calculated using PVWatts - a performance calculator for grid-connected PV solar energy systems created by the U.S. Department of Energy. The potential array performance for an HCPV array was calculated using the Department of Energy's Solar Advisor Model (SAM). PVWatts and SAM are tools used to develop preliminary electricity output estimates for grid-connected PV systems within the United States.

Weather data available through PVWatts and SAM for Tucson, Arizona, the closest available city to the proposed project area, was used to model potential electricity output from hypothetical 20 MW system(s).

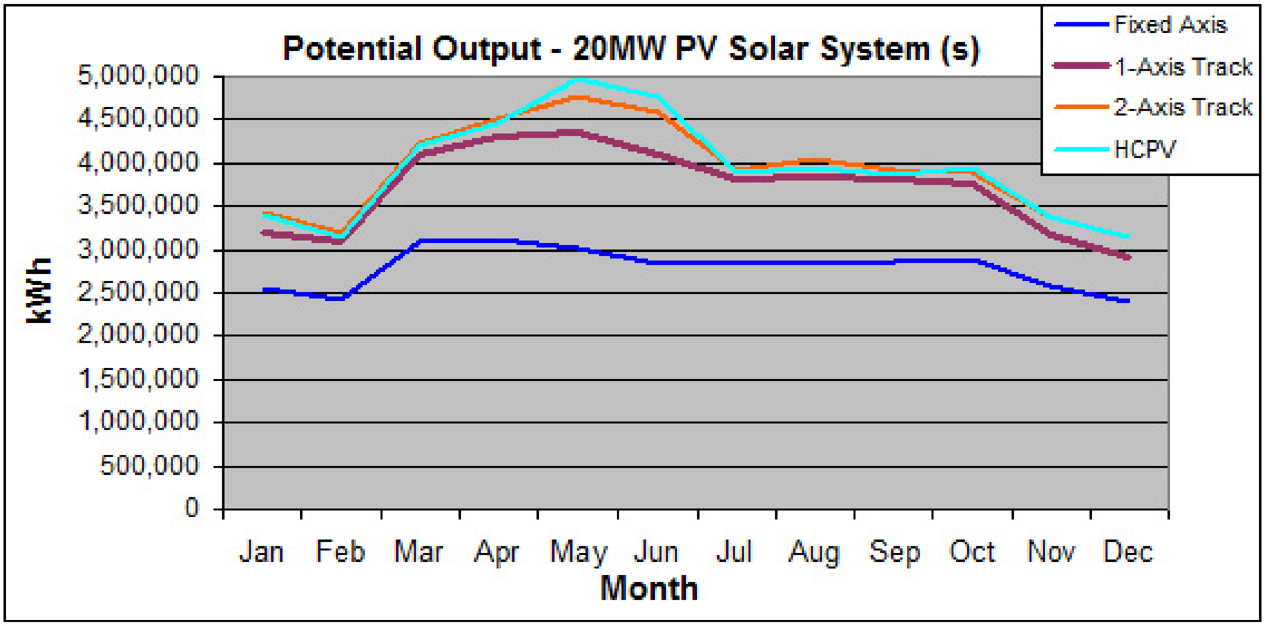


Figure 5: Estimated PV Solar System Output

PVWatts and SAM are tools used to develop preliminary electricity output estimates for grid-connected PV systems within the United States. The actual performance of a PV system will be affected by dirt and dust, shading and other site-specific factors. As a result, the output numbers in Figure 5 illustrate the potential electricity output of a 20 MW system; actual output would differ depending on the specific solar energy system used.

Incentives and Financing Opportunities

Identifying and leveraging applicable incentives and grants is an important part of making PV systems cost effective. Incentives are available at the state and federal level and include both policy-based incentives (e.g., renewable portfolio standards) and financial incentives (e.g., tax credits and rebates). A number of policies and incentives could help facilitate the development of utility-scale solar energy projects, including:

Federal Incentives

- Business Energy Tax Credits: 30% tax credit to partially offset the upfront installed cost of a solar system. Also known as Investment Tax Credits (ITCs). A Department of Treasury cash grant-in-lieu of the 30% ITC was created to provide an upfront grant equal to 30% of the applicable solar project cost. The grant will expire at the end of 2011.
    - The ITC reduces federal income taxes for qualified tax-paying project owners based on capital investment in renewable energy projects.
- U.S. Department of Energy Loan Program: DOE can issue loan guarantees to mitigate the financing risks associated with renewable energy projects. To date, over $13 billion has been guaranteed to support 17 clean energy projects across the US.

Federal Programs

- Department of Energy's Tribal Energy Program promotes tribal energy sufficiency, economic development and employment through the use of renewable energy and energy efficiency technologies.

- DOE recently offered nearly $10 million to promote efficiency and renewable energy development and deployment on tribal lands.
- Future funding is expected to be dependent on Federal budget decisions.

State Incentives

- Arizona Renewable Energy Standard (RES): Arizona has legislated a 15% renewable energy requirement by 2025. Investor-owned utilities serving retail customers are subject to the standard. These utilities are potential purchasers of renewable energy.
- Solar Energy Equipment Sales Tax Exemption: Applies to "solar energy devices or system designed for the production of solar energy for onsite consumption."
- Renewable Energy Production Tax Credit: Tax credit based on the amount of electricity produced annually for a 10-year period. Applications approved on a first-come, first-served basis until yearly cap of $20 million is reached. Annual $20M cap includes both state personal and corporate tax credit. 5MW systems and larger are eligible.
- Commercial/Industrial Solar Energy Tax Credit Program: 10 percent of the installed cost of a solar device, not to exceed $50,000 per business per tax year. Incentive provides an income tax credit for the installation of solar energy devices in Arizona business facilities.

Utility Incentives

- Tucson Electric Power periodically issues Requests for Proposals for in-state renewable energy projects to help the company meet its RES goals.
- In 2010, the Arizona Corporation Commission approved TEP's plan to spend up to $28 million annually to add up to 7 MW of company-owned or contracted solar power capacity each year through 2014.

The financial viability of a renewable energy project on the San Xavier Reservation tailings area will be dependent upon the ability of any project to take advantage of as many of these funding opportunities as possible either directly as a project owner/developer or through partnerships or other financial arrangements reached with potential solar energy developers who are eligible for the incentives listed above.

Conclusions and Recommendations

The development of a renewable energy project is a complex process that requires incentives, multiple partners, favorable market conditions and other factors that need to be identified and managed throughout a project. Amidst this complexity, the ASARCO Mission Mine tailings area offers unique and potentially innovative opportunity to accommodate and potentially expand a utility-scale solar energy project at a single location. The tailings area has existing transmission capacity, roads, industrial zoning and other critical infrastructure in place for a utility-scale PV project. Additionally, installing a solar generation plant and associated infrastructure on a formerly impaired area can help take development pressures off of undeveloped, open land ("greenfield") areas.

Dust and dirt can reduce a solar panel's efficiency by up to 20 percent. PV solar systems operating in real world conditions eventually become covered with a fine layer of dirt and dust, decreasing the amount of light reaching each cell. The amount power loss can depend on location, the type of dust, and the length of time since the last rainfall. With active mining operations still ongoing south of the proposed project area, ensuring regular cleaning of any installed PV system would help to maintain power output over time.

The potential PV system output calculations and sizes were based on estimates of available acreage in Tailings Area 1 and 2. However, the final size of any PV solar system is likely to be driven by available funding for a project and/or on the amount of power that can be sold via a purchase agreement to an energy utility or other end user.

While renewable energy market opportunities in Arizona have the potential to be strong, much of the anticipated market for a solar energy project at this site will depend on the ability to partner with an energy developer, the ability to deliver electricity at a competitive price and the ability to enter into a long-term purchase agreement with an electric utility.

Additional geotechnical stability and settlement analysis, specifically of the Nation-owned section of the tailings, may be warranted prior to building any structures on top of the tailings areas and could help move a solar project forward. The Nation may be able to obtain funding from EPA for some initial borings in the tailings area under consideration. Solar energy project developers are also likely to invest in their own geotechnical analysis of the tailings area to better understand bearing pressures and potential settlement rates at areas proposed for development prior to any project getting underway.

Appendix A: Solar Energy Information Resources

USEPA Resources	
EPA Renewable Energy Maps	http://www.epa.gov/renewableenergyland/
EPA Abandoned Minelands Team Reuse	http://epa.gov/superfund/programs/aml/revital/index.htm
EPA Guide to Purchasing Green Power	http://www.epa.gov/greenpower/documents/purchasing_guide_for_web.pdf
EPA Clean Energy Page	http://www.epa.gov/cleanenergy/
Presentations/Reports on RPSs and RECs	http://www.epa.gov/RDEE/energy-programs/state-and-local/state-forum.html#twenty
Report: "Analysis of Post-Mining Land Reuse Options for Chino Mine Site"	http://www.epa.gov/region6/6sf/pdffiles/lrnewsmay08.pdf
Solar Power Purchase Agreements	http://www.epa.gov/greenpower/buygp/solarpower.htm
Sustainable Management Approaches and Revitalization Tool (SMARTe)	http://www.smarte.org/smarte/home/index.xml
Renewable Energy Certificates	http://www.epa.gov/greenpower/gpmarket/rec.htm http://www.epa.gov/greenpower/documents/gpp_basics-recs.pdf
Developing Solar Energy on Contaminated Land	http://epa.gov/renewableenergyland/docs/solarmarket_analysis_overview.pdf
EPA/NREL Assessment sites	http://epa.gov/renewableenergyland/develop_potential_fs.htm

US Department of Energy Resources	
Renewable Energy Development in Indian Country	http://www.nrel.gov/docs/fy10osti/48078.pdf
Renewable Energy on Tribal Lands	http://www.nrel.gov/docs/fy08osti/42354.pdf
DOE Tribal Energy Program - Guide to Energy Development	http://www1.eere.energy.gov/tribalenergy/guide/
DOE Solar Energy Technologies Program	http://www1.eere.energy.gov/solar/
National Renewable Energy Lab (NREL) Solar Research	http://www.nrel.gov/solar/
NREL Job and Economic Development Impact (JEDI) model	http://www.nrel.gov/analysis/jedi/
NREL Renewable Energy Resource Maps	http://www.nrel.gov/renewable_resources/
NREL In My Backyard (IMBY) Tool	http://www.nrel.gov/eis/imby/
DOE Solar Resource Maps	http://www.nrel.gov/csp/maps.html
NREL Cost of Renewable Energy Spreadsheet Tool	http://financere.nrel.gov/finance/content/CREST-model
NREL GIS and Mapping Resources	http://www.nrel.gov/gis/
PV Watts Calculator	http://www.pvwatts.org
System Advisor Model	https://www.nrel.gov/analysis/sam/

Funding and Financial Incentive Resources

US DOE Tribal Energy Program Grants	http://apps1.eere.energy.gov/tribalenergy/government_grants.cfm#Tribal
Database of State Incentives for Renewables & Efficiency (DSIRE)	http://www.dsireusa.org/
DOE Office of Energy Efficiency and Renewable Energy Financial Opportunities	http://www1.eere.energy.gov/financing/
DOE Power Purchase Agreement Checklist	http://www.nrel.gov/docs/fy10osti/46668.pdf
SMARTe Financial Resources	http://www.smarte.org/smarte/tools/FinancingResources/index.xml?mode=ui&topic=financialresources
EPA Renewable Energy Incentive Fact Sheets	http://www.epa.gov/renewableenergyland/incentives.htm
EERE Financial Opportunities by Audience	http://www1.eere.energy.gov/financing/audience.html
DOE - Third-Party Financing and Power Purchase Agreements for Public Sector PV Projects	http://apps1.eere.energy.gov/wip/pdfs/tap_webcast_20090527_coughlin.pdf

References

Physical Resource Engineering, Inc., 2009, "Preliminary Investigation of Post Closure Slope Stability: No.1, 2 and 3 tailings facility, Mission mine" Sahuarita, Arizona

Gault Group, 2008, "Mining and Reclamation Plan Asarco-mission Complex Tohono O'odham Nation San Xavier District," Sahuarita, Arizona.

Dames and Moore, 1996. "Stability Analysis Report Proposed Tailing Facility No. 4" Sahuarita, Arizona.

Resources

Re-Powering America Renewable Energy Interactive Mapping Tool: http://epa.gov/renewableenergyland/mapping_tool.htm

U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. "Siting Clean and Renewable Energy on Contaminated Lands and Mining Sites." September 2008.

Database of State Incentives for Renewables & Efficiency (DSIRE): http://www.dsireusa.org

EPA Renewable Energy Maps: http://www.epa.gov/renewableenergyland

DOE Solar Energy Technologies Program: http://www1.eere.energy.gov/solar

DOE PVWatts: http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/

DOE Solar Advisor Model: https://www.nrel.gov/analysis/sam/

RENEWABLE ENERGY OPPORTUNITIES AT ASARCO MISSION MINE SITE

United States
Environmental Protection
Agency

For Information About Tohono O'odham
Solar Development Opportunities, Contact:
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