

Final Technical Report Cover Page



Recipient Organization: San Xavier District Tohono O’odham Nation

Project Title: San Xavier District Solar Energy Project for Administration Building and Education Center

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Recipient Cost Share: 434,534.39

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1.0 Executive Summary

The San Xavier District of the Tohono O'odham Nation (District) developed grid-tied solar photovoltaic (PV) systems for two tribal buildings: the San Xavier District Administration Building and Education Center. For the Administration Building, an approximately 182-kilowatt (kW) solar PV system is projected to produce roughly 310,000 kilowatt-hours (kWh) per year and displace about 80% of the energy use of the building. For the Education Center, an approximately 73.5-kw system is projected to produce roughly 130,000 kWh per year and displace about 95% of the building's energy use. The anticipated 25-year cost savings from the combined 255-kW systems are estimated to be approximately \$1,750,000 and \$820,000 for the Administration Building and the Education Center, respectively.

2.0 Background

Established in 1937, the San Xavier District is one of the 11 Districts that comprise the Tohono O'odham Nation. Containing nearly 72,000 acres of Sonoran Desert, the District accounts for 7% of the Tohono O'odham Nation's population, with a total enrollment of roughly 2,300 individuals, of which approximately 1,200 reside within the District's jurisdiction. The mission of the District is: "To promote self-determination and provide a legacy for future generations by guiding, leading, and supporting community in the protection and preservation of the land, water, air, culture, traditions, knowledge, language and viability of community."

The District continually strives to remain in-tune with the surrounding land and the environment. Living in an arid desert climate, the Tohono O'odham people have, for centuries, sought balance and harmony with their surroundings. With climate change, and the stresses of fossil fuel shortages impacting the world's energy market, the District saw that infusion of renewable and clean energy sources would be an essential component to integrate into our tribal community for the sake of sustainability, and also to offset the cost of rising energy prices.

The District sought to accomplish three main goals when exploring the potential for renewable energy on our lands. The first goal was to utilize an energy source that is locally abundant and feasible for long term use. The second goal was to offset current District energy operating costs with a renewable energy source in our Administration Complex, which acts as a hub to the community. The third goal we sought to accomplish was to create an energy model that mat be used by the larger San Xavier District community in their homes.

Southern Arizona enjoys more than 300 days of sun per year therefore solar energy is the most feasible alternative/renewable energy source in Arizona. Because of this, the District, over the last decade, committed to the development of renewable solar energy infrastructure. In 2013, the first solar PV system (60 kW) was installed to reduce utility costs and dependance on commercial power. In 2019,

another solar PV system (100 kW) was constructed for the District's Senior Services Center and the Maintenance Building. Both projects have significantly contributed to the District's overall energy goals. The success of the past projects have demonstrated the feasibility and effectiveness of renewable technologies on tribal land, which were utilized in this project.

3.0 Project Objectives

The intent of this project was to increase self-reliance and community resilience for the Tohono O'odham Nation communities through the enhancement of tribal energy and economic infrastructure. The project objective was to install 182 kW of solar PV to power the Administration Building and 73.5 kW at the Education Center. The project aim was to make use of solar PV systems to power tribal community buildings in the District.

Benefits from this renewable energy initiative are numerous for the San Xavier District community. Benefits from this project include: 1) reduce energy purchased from the commercial utility provider, thus reducing overall operational costs to the District; 2) offset carbon dioxide (CO₂) emissions and environmental footprint; 3) increase community resilience through community outreach and education focused on the importance of renewable energy and methods by which these technologies may be implemented by homeowners in this tribal community.

Installation of the solar PV systems will allow the District to utilize a resource abundantly available in the Sonoran Desert of Arizona. Over the 25-year life of the project, the District anticipates saving \$2,571,500 and reducing its carbon footprint by 9,052 tons of CO₂ equivalent. Savings generated through reduced energy costs can be allocated to other meaningful programs that may focus on other pressing community needs.

4.0 Description of Activities Performed

The following is a list of activities that have been completed the FIRST QUARTER (November 1, 2020 to March 30, 2021):

- Cleared both construction sites.
- Mobilized storage containers and materials.
- The TPT (Transaction Privilege Tax License) has been completed.
- The TERO compliance paperwork is pending, awaiting invoice for the TERO fee.
- Engineering has been completed.
- The module procurement has been completed.
- The inverter procurement has been completed and is in transit.
- The AC equipment procurement is completed. It is being manufactured and will be in transit.

- Steel procurement is completed. The steel has been ordered and being manufactured, 4-6 weeks.

The issues that we are faced with this quarter:

- Certain materials are on back-order due to weather conditions in Texas and other parts in the country where materials are being fabricated and the cost of materials have escalated.
- Due to COVID, skilled labors are also scarce.

There are no budget issues. We are on schedule to meet the grant's deadline.

The following is a list of activities that have been completed the SECOND QUARTER (April 1, 2021 to June 30, 2021):

- Tribal Employment Rights Office approved the compliance plan
- Steel was received and installed
- For the Administration Building and the Education Building:
 - The installation of the AC electrical gear has been completed
 - Solar panel installation began and will be completed in July 2021
 - DC wiring installation will begin in July 2021
 - Traditional blessing of the grounds of both sites was completed
- Completed underground conduits
- Installed conduits for data lines

The following is a list of activities that have been completed the THIRD QUARTER (July 1, 2021- September 30, 2021):

- Completion of solar array installation at both sites
- Completion of DC wiring
- Completion of data line installation
- Connect all necessary lines to the grid
- Traditional blessing of the completed project at Education site

The following is a list of activities that have been completed the FORTH QUARTER (October 1, 2021- December 31, 2021):

- Completion of solar array installation at both sites
- Completion of the connections for Administration site
- Traditional blessing of the completed project at Administration site
- Completion of connection to District's IT Network
- Utility Authority inspected all connections and certified
- Began one year data collection
- Bi-weekly inspections of invertors and solar panels
- Power Point presentation to DOE in November 2021

The following is a list of activities that have been completed the FIFTH QUARTER (January 1, 2022- March 31, 2022):

- Requested an extension and it was granted for 12/31/2022

- Maintenance cleaned the solar panels
- Trained maintenance staff on the operations and maintenance of solar panels. (Inverter, emergency shut off switches, and overview of whole system)
- Planned Open House Event for April 13, 2022. Sent out invitations to Tohono O'odham Nation District's Leadership, Districts, and staff. Owner of RDS will fly in from Dallas, Texas to assist with the event and presentation.
- Monitoring the generation of solar power.
 - Administration Site produced:
 - January 23.45 MWh
 - February 25.12 MWh
 - March 31.05 MWh
 - There was \$2,800 cost savings in our March's Electric bill.
 - Education Site produced:
 - January zero data due to issue with transmitter
 - February 8.74 MWh
 - March 13.37 MWh
 - There was a \$1,000 cost savings in our March's Electric bill.

The following is a list of activities that have been completed the SIXTH QUARTER (April 1, 2022- June 30, 2022):

- Held an Open House Event on April 13, 2022. We had 16 attendees. The owner of RDS gave a presentation and we gave the participants a tour of the panels.
- Monitored the generation of solar power.
 - Administration Site produced:
 - April 34.29 MWh
 - May 36.92 MWh
 - June 31.43 MWh
 - Education Site produced:
 - April 15 MWh
 - May 15.65 MWh
 - June 13.54 MWh

The following is a list of activities that have been completed the SEVENTH QUARTER (July 1, 2022- September 30, 2022):

- Monitored the generation of solar power
 - Administration site produced:
 - July 29.71 MWh
 - August 29.29 MWh
 - September 27.91 MWh
 - Education site produced:
 - July 12.83 MWh
 - August 11.98 MWh
 - September 12.05 MWh

- Monitored Electric Bill Savings:
 - Administration site electrical savings:
 - June 2021 \$4,657.99 without solar
 - June 2022 \$1,732.52 with solar
 - July 2021 \$4,561.33 without solar
 - July 2022 \$2,830.16 with solar
 - Education site electrical savings:
 - June 2021 \$1661.47 without solar
 - June 2022 \$613.77 with solar
 - July 2021 \$1,409.37 without solar
 - July 2022 \$1,041.52 with solar
- Maintenance staff inspected invertors and solar panels twice in July, once in August, and once in September.

The following is a list of activities that have been completed the EIGHTH QUARTER (October 1, 2022-December 31, 2022):

- Conducted second and final Open House Event on December 10, 2022 at 9 a.m.
- Our Maintenance staff inspected invertors and solar panels once a month this quarter.
- Sandra Alvarez (San Xavier Director of Administration and DOE Grant Business and Technical Contact), John Baskett (San Xavier Principal Planner), Richard Grijalva (San Xavier Director of Economic Development), and Chris Gastelum (San Xavier Housing Manager) attended and presented at the 2022 U.S. Department of Energy Office of Indian Energy Program Review Conference in Denver Colorado on November 14 – 18, 2022.
- Monitored the generation of solar power
 - Administration site produced:
 - October 26.75 MWh
 - November 24.31 MWh
 - December 17.38 MWh
 - Education site produced:
 - October 7.56 MWh. System was offline from October 14-24. Issue is unknown but was back online October 25, 2022. Average was 420 kwh a day.
 - November 8.43 MWh. System was off-line from November 2-6. Issue is unknown but was back online November 7, 2022. Average was 365 kwh a day.
 - December 8.02 MWh
- Monitored Electric Bill Savings:
 - Administration site electrical savings:
 - In a 7-month period, we saved \$15, 000 in our Electric Bills. That's a 42% savings.
 - Education site electrical savings:

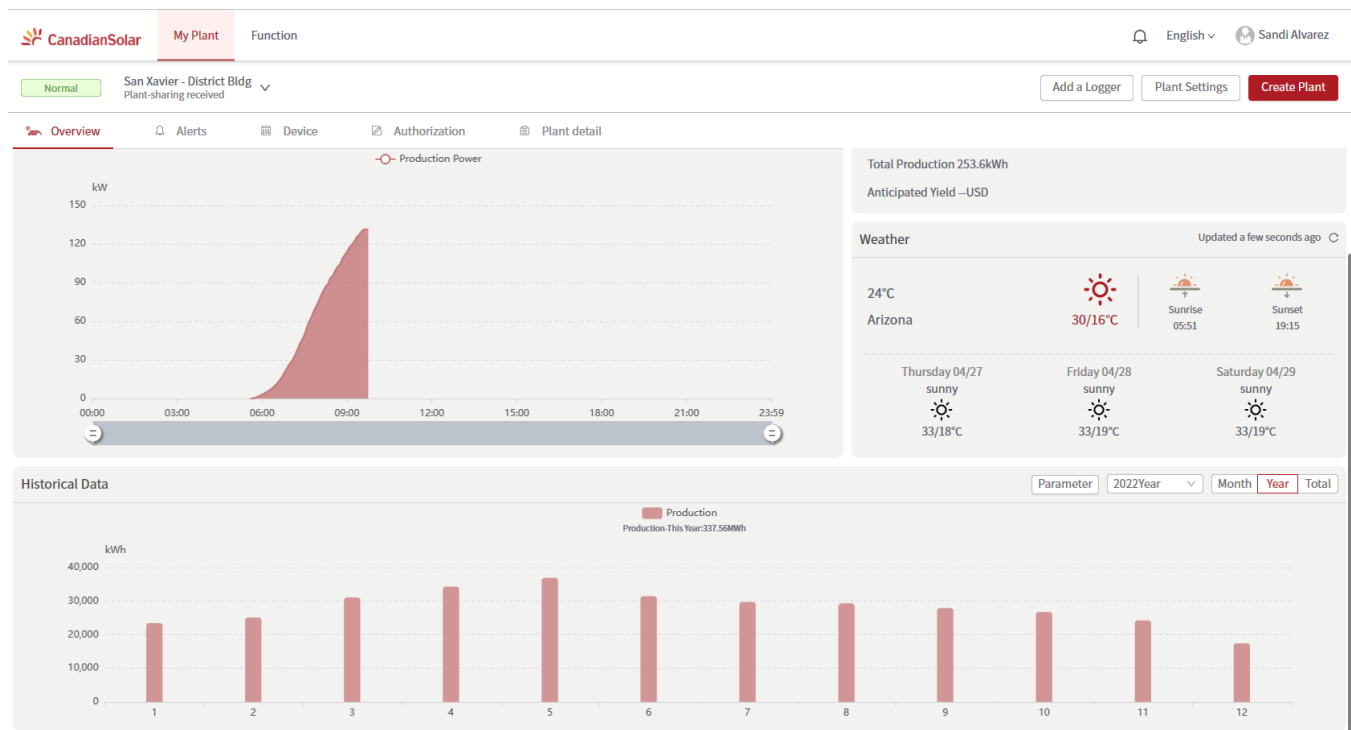
- In a 7-month period, we saved \$6,400 in our Electric Bills; that's a 26% savings.
- Monitored the generation of solar power for one year:
 - Administration Building 337.56 MWh in 2022
 - Education Center 127.22 MWh in 2022

5.0 Conclusions and Recommendations

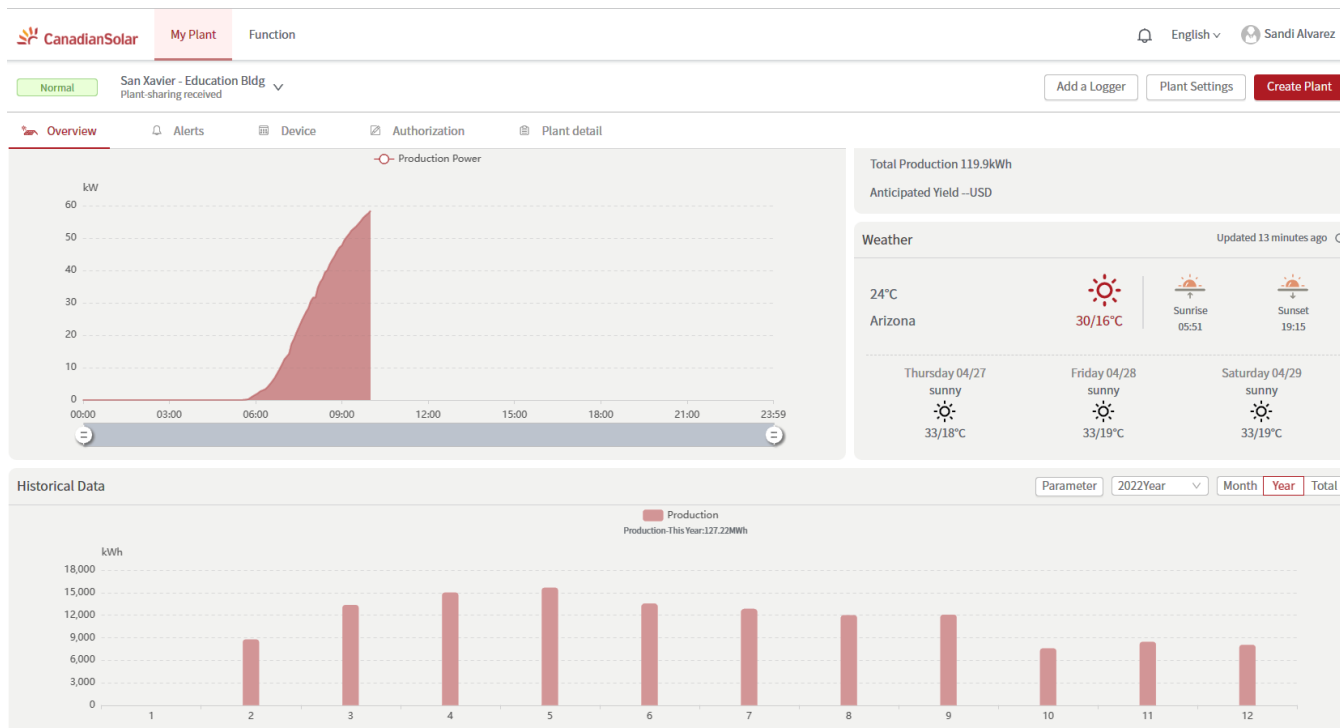
The genesis of this project was inspired from our Mission Statement at San Xavier District of the Tohono O'odham Nation regarding our wish to promote self-determination. This renewable energy project has helped us become more self-reliant on natural resources within our own lands and rely less on power sources originating elsewhere, off of Tribal Lands. Our goals and objectives have all been met which strengthen our vision to promote self-determination. Some data highlights of this project which reflect this success are listed below.

We use Canadian Solar Monitoring System. Below is a snapshot of 2022. The Administration Building generated 337.56 MWh in 2022. The Education Center generated 127.22 MWh in 2022.

Administration Building



Education Center



6.0 Lessons Learned

From the initiation and onto the completion of our renewable energy project here at San Xavier District, there were various trial and error scenarios. Upon completion of the installation of our solar PV set-up, there were some key takeaways and lessons learned. Some of these lessons are as follows:

1. Involving our Maintenance Department in the beginning and throughout the project should have been heightened. Our Maintenance staff maintain the cleanliness of the panels and troubleshoot when an inverter is not reading correctly. Involving them from the beginning would have brought them more knowledge on the entire system.
2. More collaboration with our utility authority was needed at the beginning of our planning process. We are the first District to have solar energy and this is new to our utility authority. We are producing more energy than the credit received from our utility authority. We are working with them to resolve this.
3. More in-depth research on utilizing battery banks during off peak power production or storing excess energy production was needed. This research should have been conducted before selecting our current solar panel system.
4. Site selection is vital when considering placement of free-standing (non-building mounted) solar PV panels. We didn't consider the proximity of our agricultural fields to our set-up, and the dust/debris from agricultural activity that accumulates on each PV panel from this activity.

7.0 Pictures

Completed project at the Administration Building





Completed project at the Education Center

