DOE Office of Indian Energy – Final Technical Report

Cover Sheet

Recipient Organization:	Flandreau Santee Sioux Tribe (FSST)
Project Title:	Solar Energy Development on FSST Reservation
Date of Report:	**April 23, 2023**
Award Number:	DE-IE0000118
Total Project Costs:	$769,576
DOE Share:	$384,768
Recipient Cost Share:	$384,808
Project Manager:	Ryan Kills-A-Hundred, 605-864-8157
Project Partner:	Nebraska Renewable Energy Systems Robert Byrnes, 402-201-7659

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2. Executive Summary:

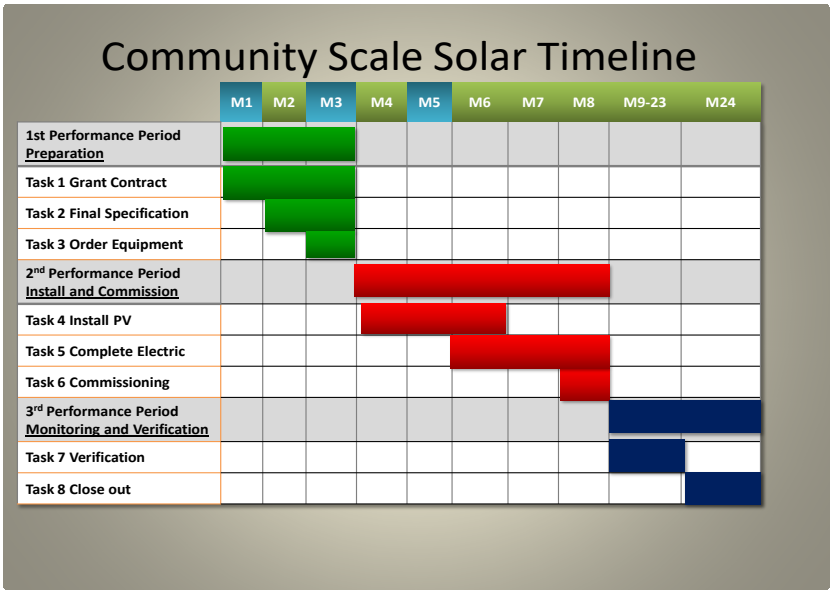
FSST undertook this project to install PV solar with the goal of reducing retail power consumption at 11 Tribal buildings. A combined total of 318kW has been installed over these sites and power savings are being recorded on a regular basis.

The Tribe entered into the project with several specific objectives that made this a unique effort. First of all, all of the systems were installed by Tribal maintenance personnel with some technical support. This model had been developed with previous projects that Nebraska Renewable Energy Systems (NRES) had completed and had shown great success. This approach helped to ensure we met the DOE goal of 'building capacity' within the Tribe. There was some skepticism about this model in Flandreau at the onset of discussions, but the excellent final results spoke for themselves!
A second objective was to overcome the sore lessons that were learned after FSST invested in early deployment of pole mounted solar systems that were not sturdy enough for SD winds. It was a very courageous decision to move forward again with solar pole

mounts (and other types) in this very high wind area. We shall report that the Tribe was fully successful in achieving what they set out to do there.

The final major objective was to deploy the PV Solar systems in such a way as to integrate them into their surroundings wherever possible. In some cases the mounting choice was clear, but in several locations, the system was designed to be a functional and aesthetically enhancing part of their surroundings. These elevated systems allowed the PV system to act as a shade structure and create useful space under them as well as making power. FSST had these elevated ground mount systems specially designed for our application by Ironridge and were rated for the tough winds of South Dakota (120MPH+).

3. Project Objectives:



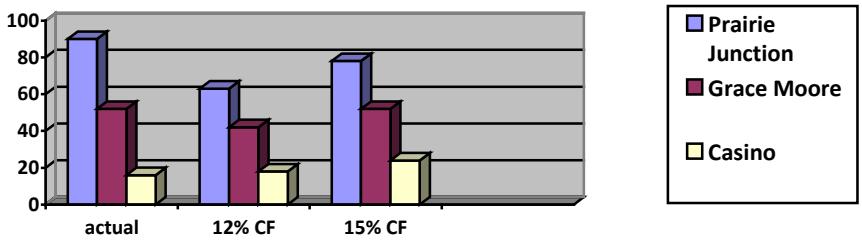
Project objectives are shown above. Major tasks were to prepare, install and verify operation of the 11 solar systems. These systems were all commissioned within the first year and have been in the monitoring program for about two years (on average).

The FSST PV solar project was very concise and all objectives were met and commentary on how that all went is included in section 5. The preparation period was critical to ensure we had final designs and specifications for all systems and placed all orders up front so that materials were available when needed. Overall, outside of the seasonal impacts, the systems deployed well.

The installation period was prefaced by training to FSST maintenance personnel by NRES so that safety and technical information was shared. The ‘big picture’ of the 318kW project was reviewed and the many small points regarding the various mounting systems. The project intentionally include all of the various types of mounting systems for maximum exposure and training opportunities (building capacity). These included single pole mounts as well as multiple pole mounted shade arrays, standard and elevated ground mounts and flush roof mounts using S-5! Clamps on their standing seam metal roofs. Once installed, the systems were commissioned.

A very important component of the project is long term monitoring and savings verification. This physical verification of operation also allows FSST to collect production data regularly to see actual figures for produced offset amounts. To date, the systems have saved FSST an estimated $45,000 by offsetting approximately 400 MWh since the projects were started at the current offset value of $110/MWh.

We had originally specified 318kw installed and at a 15% capacity factor, we would expect about 417MWh/year saved, but our numbers were slightly less and came closer to 12|% where data was available to make these assessments, like at Prairie Junction 60kW system that has been operational about 1.5 years. Other site are not so clear because of elapsed time, maint issues, etc.



Comparing the estimated annual data of some selected systems it can be seen that actual capacity factors noted by production range from 12% to 15%. Why this difference between projected capacity factors (CF). The primary reason is the low incident angles we selected for two reasons, wind survivability and maximum solar capture in the Summer, when power use and cost is higher. Snow cover is another that can very dramatically reduce production during Winter months and low incident angles reduce solar melt off. This trade off between production and survivability is real and we believe a slightly lower angles to ensure to systems are not damaged is the best way to minimize risk and capture value. This approach was verified when a storm packing 110mph winds resulted in zero failures in any solar mounting systems. After the early experiences of FSST with solar, this was no small thing.

The systems performed well with only some minor maintenance needed. Some sites, like Prairie Junction have performed very well and have achieved the desired energy production capacity. We had anticipate 417MWhr saved annually and the data indicates we are actually making about 320MwH which corresponds to the 3% average capacity factor loss we noted above.

4. Description of Activities Performed:

Our project activities following the preparation task were controlled by weather. We were able to commission the Pharms/grow system completely and installed pole mount pipes before Winter set in in 2020. Having the poles installed already allowed us to follow up with completing installation right away before Spring, when we were preparing to install the balance of the systems.

As the project progressed, we had some steps overlap between different systems to allow concrete set or something, but generally we stayed on one project site and completed installation to the point it was ready for the electrician and commissioning.

FSST Maintenance had regular duties as well supporting Tribal operations, so personnel able to support the PV installations was variable. To further ensure development of internal capacity and maximum value to the grant, tools and equipment needed for the installations were purchased an in kind cash match. The extra deep holes for the pole mounts were undertaken by the city who owned a special deep drill, otherwise FSST will be ready in both training and tools to install their own additional systems in the future with only a minimum of technical support, if any. This was a major goal for this project.

These skills will be both refreshed and expanded as we prepare to install a 40kW system on the recently completed FSST Nursing Home which will utilize a ballasted tray system to support panels on the flat roof. This would represent a 6th approach to mounting panels and one they have not used yet, but with tools, skills and confidence gained by this DOE project.

5. Conclusions and Recommendations:

We had several specific successes that went beyond simply achieving the goals we had set out to accomplish. One was that the systems had been designed for extreme weather and they proved themselves well in May of this year when the site saw recorded wind speeds of 120MPH+. There was no system damage as a result of the storm, except one ground mount that was damaged by flying debris. The elevated panel sites saw no damage as the additional height allowed ground debris to go underneath the mount and not do any damage to the panels. All of our hard work on design and building strong paid off!

The 20-30 degree incident angles we installed the panels at provided the least wind exposure and uplift as well, enhancing the survivability of the system in extreme storms and coverage by snow.

Installation of these systems throughout the core Tribal area has made the PV Solar systems a part of daily Tribal life. They serve as a visible reminder of the Tribes commitment to energy stewardship and sustainability. This has spurred at least two privately owned systems and installation of another 40kW on a new construction project (Tribal Nursing Home) where the roof was designed for the solar loading in the design of the roof before construction.

The process of training FSST personnel to install the systems saved a lot of money and all materials were purchased directly at wholesale pricing for very efficient cost points. Ground mount systems and S-5 based systems were being installed for about $2/watt installed cost.

Because the interconnection policy in South Dakota was more like ‘net billing’ than ‘net metering’, system sizes were carefully selected by studying years of past power use. Systems were sized for about 30% offset (with a 50kW cap), so that a bare minimum of

energy was pushed back to the grid as excess. These excess deliveries to the grid were only valued at 'avoided cost' so we specifically tried to ensure maximum retail value offset was achieved for best economy and ROI.

The project was described in a local story in the Moody County Enterprise, 11 Dec 2019. Presentation at DOE Energy Conference 12/20 and 11/21.

6. Lessons Learned:

1. This was a major undertaking for the FSST and with any such effort, a review of challenges and approaches to addressing them are critical to ensure that we learn and grow from the experiences. In the future, it is recommended to others, to define the criteria for all equipment purchased with federal grant funds. Solar panels have greatly improved in efficiency and cost over the last decade. It is critical for tribes to understand three key factors in selecting a solar panel and/or inverter technology, for a specific application: (1) Size; (2) Durability; and (3) Warranty. FSST learned these lessons after paying for equipment that was defective and/or out of warranty.

2. The interconnection agreements with the City of Flandreau had to be developed from scratch which took much longer than we thought, though it did not hold up any production as units were brought online after state electrical inspection. The primary lesson learned here is that if the tribal project is located in a state that historically, has not embraced renewable technology to the extent that other states have, there will be a learning curve for both the Tribal project and the local utility, especially if it is a municipal utility and not a larger cooperative or an investor-owned utility. As a result, it make take longer to negotiate connection agreement with an outside utility. This will require a more thorough understanding of the state's utility laws by the Tribe's legal counsel and the state public utilities commission rules and regulations regarding offsetting power with locally generated renewable energy.
   The utility billing records are different between the two utility companies serving this project location: (1) City of Flandreau Municipal Utility – monthly reading and charge provided only. No historical data for comparison. The bills do not show that the Tribe is being compensated for its energy during peak months when the City is supposed to purchase surplus power it in accordance with the interconnection agreements;
   (2) Sioux Valley Energy – current month, previous month and same month in previous year KWH provided on billing. It will require the state PUC to require standardization of billing data if there is to consistency in tracking actual savings in energy use and cost savings. (see bills attached to this report)

3. Personnel losses and turnover created challenges with reporting requirements, but this was just one of the reasons why we had trouble getting quarterly reports together sometimes and requested an extension to close the grant out. Personnel losses are always a factor and will always have the potential to create challenges for the grant team. However, a lesson to be learned also includes DOE staff and independent contractors, as well. Not all tribes use the same financial accounting software and may not all have the same capabilities in documenting cost sharing or "billable hours", to borrow a term from the legal department. FSST finance encountered some difficulties

in documenting labor hours for casual labor that was hired for the solar installation work. The DOE contractor required breakdown of costs after the fact, and as a result, tribal finance had to make a good faith effort to reconstruct and document these costs to be eligible for cost sharing and/or reimbursement. The recommendation to DOE is to request or require specific training and orientation with ALL tribal solar project staff and/or contractors, so that there is a clear understanding among all parties about how to collect required data for the finance department. Despite these “difficulties”, this experience was a good learning experience for FSST and will be valuable as they continue to explore and develop renewable energy solutions for the Tribe. The same can be said of the local non-tribal utility provider.

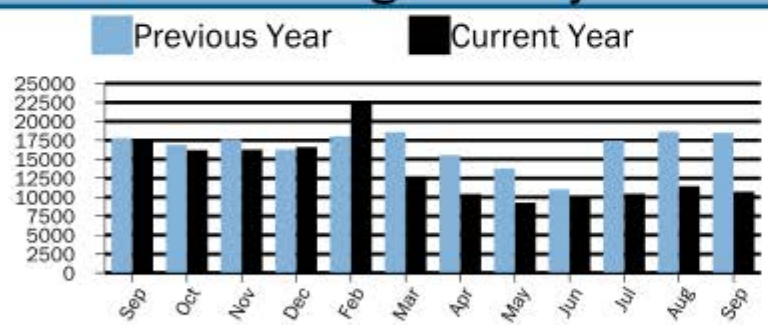
4. The elevated ground mount systems were a great success in creating usable space under the panels while demonstrating better storm resiliency as described above. While solar parking lots are common in the southwest or California, they are not common in the Northern Plains. The introduction of this type of structure on the FSST campus was a success. This type of construction was more challenging than the standard ground mount, so a technique using a pre-assembly approach on the ground and lifting into place with the rented 6k forklift was developed to make installation quicker and easier.

PRAIRIE JUNCTION
47223 SD HIGHWAY 34
COLMAN SD 57017-6543

Service Address: 47223 HWY 34 PRAIRIE JUNCTION **Map Location: 014-1-019-02-1-2**

Meter Number	Rate	Services From	Services To	Readings Previous	Readings Present	Difference	Meter Multiplier	kWh Usage	Demand Usage
85339	GENERAL SERVICE	08/01/21	09/01/21	55577	55845	268	40	10720	29.480
85339	SOUTH DAKOTA RENEWABLE	08/01/21	09/01/21	130	148	18	40	720	0.000

kWh Usage History



COMPARISONS	DAYS	KWH	AVG TEMP	AVG KWH
Current Month	31	10720	70	346
Previous Month	31	11440	71	369
Same Month Last Year	31	18480	70	596
Avg Cost Per Day: 28.42				

Current Service Detail

ENERGY CHARGE	10,720 kWh @ 0.10260	1,099.87
ENERGY CHARGE	720 kWh @ -0.02250	-16.20
WAPA CREDIT		-357.50
BASIC SERVICE		100.00
SUB TOTAL		**826.17**
TAXES		53.99
OPERATION ROUND-UP		0.84
TOTAL CURRENT CHARGES DUE		**881.00**
PRIOR BALANCE AS OF BILLING DATE		0.00
ELECTRIC MONTHLY BILLING		881.00
TOTAL AMOUNT DUE		**881.00**

City of Flandreau, SD
1005 W Elm Ave
Flandreau, SD 57028

(605) 997-2492

FIRST CLASS POSTAGE PAID FLANDREAU, SD PERMIT NO. 3

CODE	METER READING		USAGE	AMOUNT
	PREVIOUS	PRESENT		
ELEC	82,416	86,979	4,563	439.73

AFTER DUE DATE PAY	
$483.70	
ACCOUNT NUMBER	AMOUNT DUE
[redacted]	$439.73
DUE DATE	STATUS
4/17/2023	Active
SERVICE FROM	SERVICE TO
2/15/2023	3/15/2023
SERVICE ADDRESS	
603 W BROAD AVE	

SERVICE ADDRESS
603 W BROAD AVE

FORWARDING SERVICE REQUESTED

PLEASE RETURN THIS STUB WITH PAYMENT

AMOUNT DUE	DUE DATE	STATUS
$439.73	4/17/2023	Active
AFTER DUE DATE PAY	ACCOUNT NUMBER	
$483.70	[redacted]	

FSST OFFICE
PO BOX 283
FLANDREAU, SD 57028-0283

City of Flandreau, Utility Department

1005 W Elm Ave
Flandreau, SD 57028-1404
605.997.2492 • www.cityofflandreau.com

FLANDREAU, SOUTH DAKOTA 57028

FIRST CLASS POSTAGE PAID PERMIT NO. 3

SERVICE AT 603 W BROAD AVE

READING DATE 07/15/22

TEMP - RETURN SERVICE REQUESTED

8/15/2022

ACCT. NO. [redacted]

FSST OFFICE
PO BOX 283
FLANDREAU,SD 57028-0283

CHARGES/CREDITS	METER READING PREVIOUS	PRESENT	USAGE	AMOUNT
PREV BAL				397.68
RECEIPT				-397.68
ELEC	06/15/22 46907	51289	4382	515.28
CUR CHRGS				515.28
TOTAL DUE				515.28

AMOUNT DUE NOW

515.28

After 8/15/2022 Pay 566.81

AFTER 8/15/2022 PAY 566.81 AMOUNT DUE NOW **515.28**

RETURN THIS PORTION WITH PAYMENT TO THE CITY OF FLANDREAU

[redacted]

ACCOUNT NUMBER