Tar Creek Solar Reuse Report

Tar Creek Superfund Site, Ottawa County, OK

October 2024

Overview

The Tar Creek Superfund Site is located within the Quapaw Nation, Ottawa County, Oklahoma. It is part of the historic Tri-State Mining District where surface and subsurface mining for lead and other metals led to widespread impacts throughout multiple jurisdictions. The US Environmental Protection Agency (US EPA), Oklahoma Department of Environmental Quality (ODEQ), and Quapaw Nation remedial action partners have worked for decades collaboratively on remediation of tribal land that is contaminated in and around the communities of Quapaw and Picher.

The Quapaw Nation actively seeks opportunities to integrate cleanup and reuse throughout these areas for the community's benefit. Recently, tribal partners have focused on solar renewable energy reuse opportunities. In the summer of 2023, the US EPA's Superfund Redevelopment Program (SRP) initiated work with Quapaw Nation's Environmental and Realty/Trust Services departments on a solar reuse assessment for the Tar Creek Superfund Site (the Site) in Ottawa County, Oklahoma. This reuse assessment is an update to the 2019 Solar Reuse Assessment sponsored by SRP in partnership with the US EPA Region 6, the Quapaw Nation and the Grand River Dam Authority (GRDA).

SRP worked with the Quapaw Nation to assess tribal business energy usage, evaluate cleanup and remediation status and analyze electric transmission infrastructure. The goal of the assessment was to identify areas with potential for solar

Figure 1: Project location.

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development near tribal offices and businesses to offset tribal energy usage.

The assessment identified potential project size, economics, ownership, development models and incentives to help Quapaw Nation partners assess the next steps for solar reuse and project financing. This report summarizes the solar reuse assessment, provides information about potential project ownership and development options and outlines next steps for solar reuse.

Site Context

The Tar Creek Superfund Site encompasses Ottawa County in northeast Oklahoma. While the entire county is considered part of the Site, there are no clearly defined boundaries and it consists of areas throughout Ottawa County impacted by historical mining wastes. The Site is in the Tri-State Mining District, which spans parts of Oklahoma, Kansas and Missouri. Abandoned mining operations from the early part of the 20th century left millions of cubic yards of lead-, cadmium- and zinc-contaminated mill waste (locally known as "chat") as well as metals-contaminated soil all over the Site. In addition to the chat, there are hundreds of miles of underground abandoned mines, now filled with acid mine water, which create potential land stability limitations for future development. The US EPA, the ODEQ, and the Quapaw Nation are partner agencies for cleanup of the Site's mining waste and associated contaminated soils.

Quapaw Nation Energy Usage and Demand Assessment

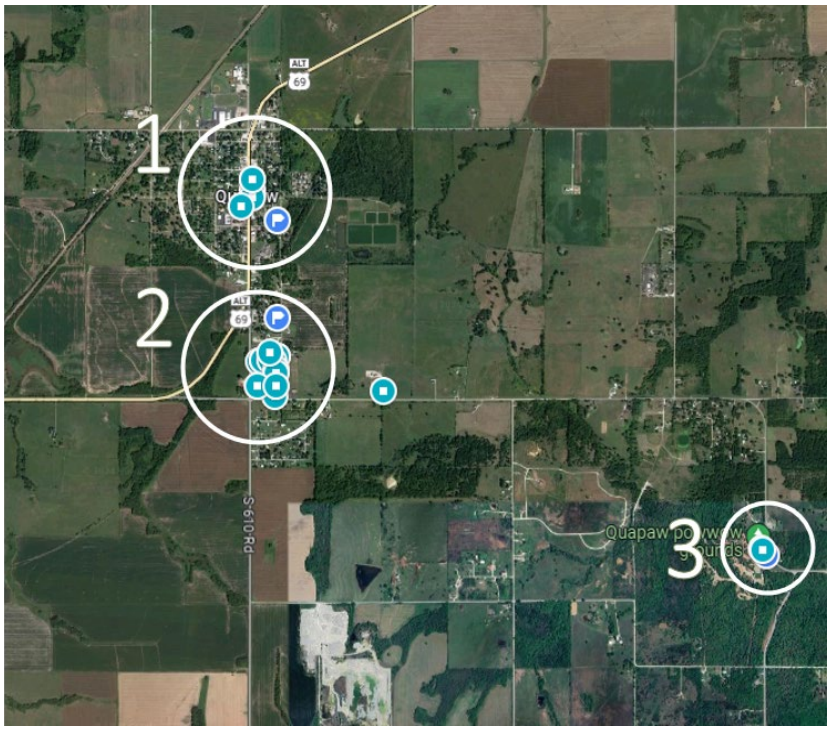
In 2019, SRP funded a solar reuse assessment and worked with the US EPA Region 6, the Quapaw Nation and GRDA to assess solar reuse at the Site. The analysis resulted in four potential project areas, one of which was prioritized by project partners. The 1,115-acre project area, known as "Bird Dog," was further evaluated for solar reuse. After discussion with property owners and utility partners, the Quapaw Nation tribal government decided to shift focus to several other previously identified areas and requested support for a follow-up (Phase 2) solar reuse assessment.

Quapaw Nation priorities have shifted from a focus of a utility-driven solar development approach to evaluate opportunities for community solar that can help to advance tribal energy sovereignty goals. This analysis focuses on identifying energy needs at tribal government facilities and businesses and seeking potential solar development opportunities that could be located nearby. The information below includes analysis of property ownership, cleanup status, proximity to infrastructure and electric power usage to inform future project decision-making.

Figure 2: Chat piles at the Tar Creek Site.

Utility Analysis

Using electric billing records provided by Quapaw Nation, SRP analyzed the amount of energy consumed annually by different users across Quapaw Nation. The analysis identified three areas with clusters of tribal government facilities and businesses with the highest electricity demand (Figure 3). Areas 1 and 2 are located within Quapaw and include government buildings and housing. Area 3 includes the Powwow Grounds and Tribal Administration building. This information in addition to partner priorities and a feasibility analysis helped to identify areas that could be suitable for siting a solar photovoltaic (PV) array.



Area 1
Quapaw Services Authority
Fire & Emergency Medical Services
Quapaw Farmers Market & Food Hub
Environmental and Realty

Area 2
Tribal Elder Housing
Quapaw Nation Fitness Center
Quapaw Elders Activity Center
O-Gah-Pah Learning Center
Robert Whitebird Cultural Center

Area 3
Quapaw Tribal Powwow Grounds
Tribal Administration Building

Figure 3: Utility clusters.

Figure 4: Environmental Realty Building.

Figure 5: Robert Whitebird Cultural Center.

Solar Suitability Analysis

Based on electricity usage, remediation status and available land, SRP identified two areas that could accommodate a solar PV array in proximity to higher electricity usage areas. These potential solar footprints are shown in Figure 6. The approximate area available for each solar footprint is shown in Table 1.

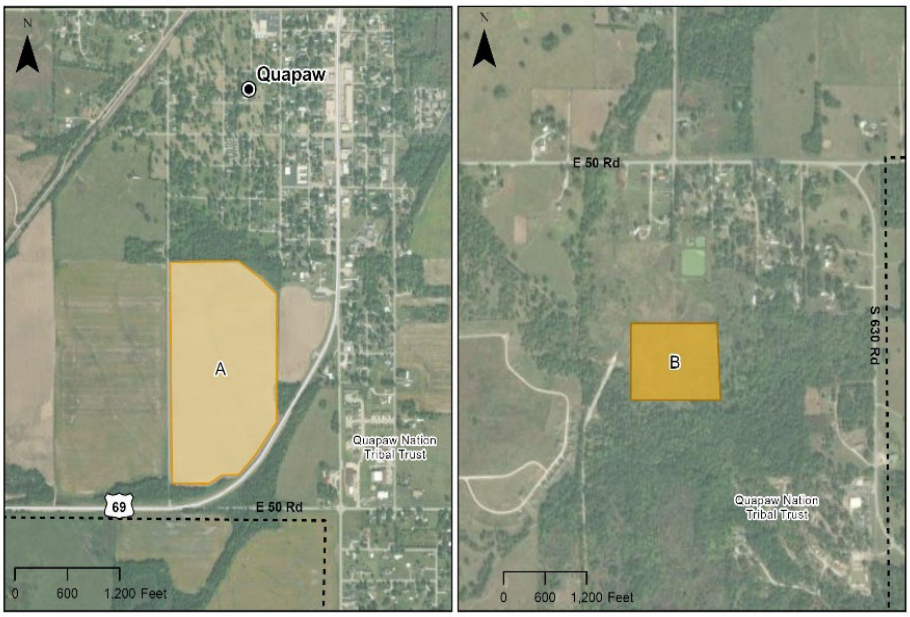


Figure 6: Potential project footprints.

Area A is approximately 60 acres large and has an estimated capacity of 36,433 kilowatts (kW). Area B is approximately 10 acres large and has an estimated capacity of 6,104 kW.

	Size (acres)	Estimated Capacity (kW)*
Area A	60	36,433
Area B	10	6,104
*Based on the System Advisor Model (SAM) https://sam.nrel.gov/		

Table 1: Estimated capacity of solar footprints.

Potential Solar Generation Options

SRP compared the potential generation of the two project footprints to the utility use nearby to approximate the surplus energy that could be produced (Table 2). Annual utility usage near Area A is approximately 1,042,344 kWh. The potential generation for Area A is nearly 55 times that, which leaves a surplus of 54,129,279 kWh of energy. Area B is smaller, but still produces a surplus of 9,022,252 kWh.

SRP used EPA's Greenhouse Gas Equivalencies calculator to estimate the CO2 reduction created by solar generation from both footprints. Area A would generate approximately 38,360 metric tons of CO2 equivalent reductions. This is equivalent to

	Area A – 60 acres	Area B – 10 acres
Potential Generation (kWh)*	55,171,623	9,242,992
Estimated Annual Utility Usage (kWh)**	1,042,344	220,740
Surplus (kWh)	54,129,279	9,022,252
Estimate of Metric Tons of CO2 equivalent reductions***	38,360	6,394
*Based on monthly utility of data provided by Quapaw Tribe.		
**Solar output estimates were modeled using estimated footprint sizes and NREL's pvWatts calculator.		
***From: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.		

Table 2: Renewable energy analysis for two project footprints.

9,000 gasoline powered cars driven for a year or 500 tanker trucks worth of gasoline. Area B would generate approximately 1,500 gasoline powered cars driven for a year or 35 railcars of coal burned.

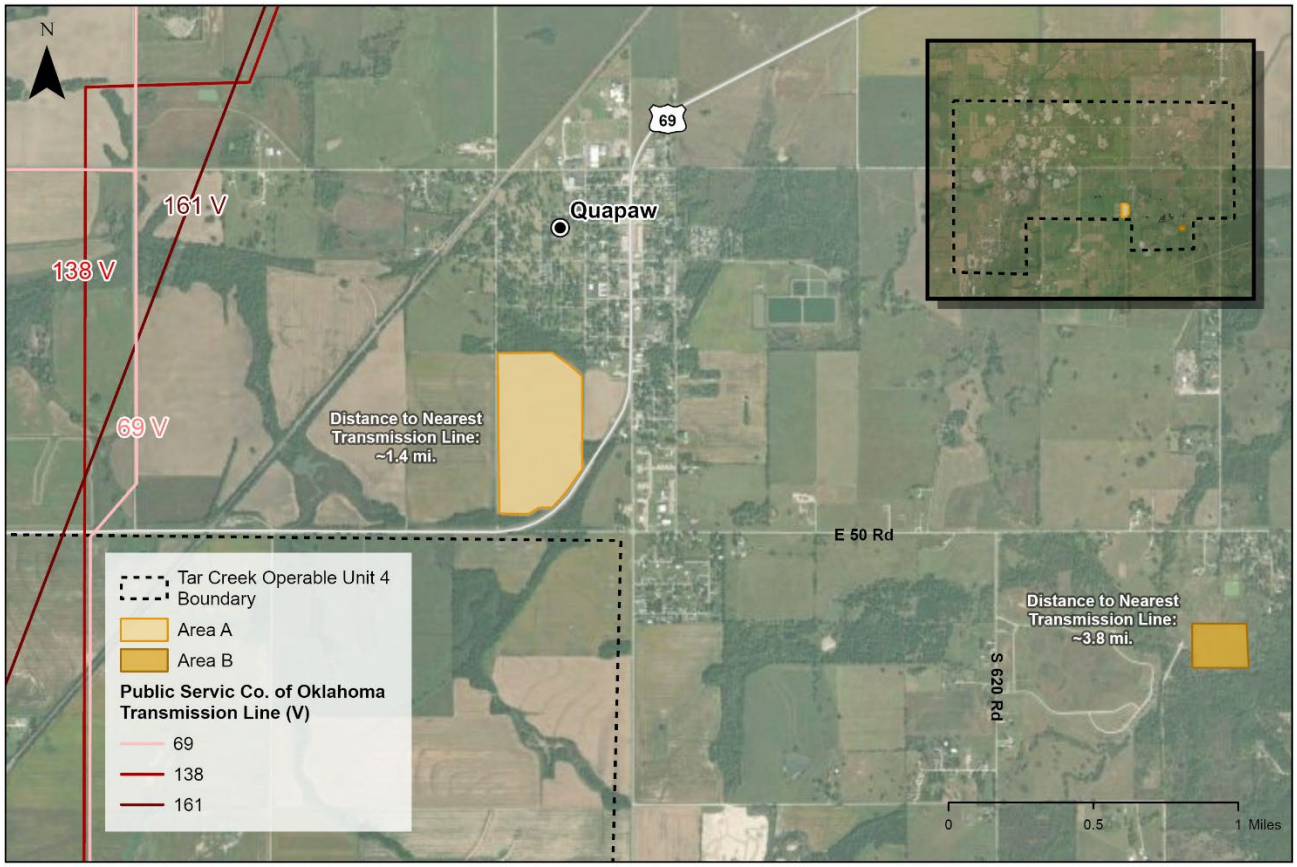


Figure 7: Distance to Transmission.

Remedial Considerations

SRP analyzed the cleanup status, distance to transmission and ownership for both footprints to confirm that they would be suitable for solar generation. Remediation is complete within both potential footprints. Area A was previously remediated for agriculture and grazing. Area B is known as the Catholic 40. It was remediated for habitat restoration purposes. The US EPA and Quapaw Nation representatives anticipate the remedy at both locations will permit solar installation.

Transmission and Infrastructure Considerations

Tribal partners are considering options for interconnection with utility owned transmission lines, as well as opportunities for developing microgrid connections and battery storage for specific clusters of electric customers. Potential solar project areas A and B are both less than one mile from utility users and could offer microgrid connections dedicated to clusters of government offices or businesses. Creating a microgrid system in which local solar panels are backed up by batteries can create a reserve of energy that can be used during a power outage.

Area A is within a ½-mile of utility users in Quapaw and 1.4 miles from a major transmission line. Area B is within ½-mile of the Powwow Grounds/Tribal Administration building and about 3.8 miles from a major transmission line (Figure 7). Potential solar project areas A and B are both close to tribal energy users and could help power a

microgrid but are further from major transmission lines which may be an obstacle for grid-connected solar development.

Potential Project Costs

SRP analyzed project costs to estimate the cost of installation and ongoing operations and maintenance (O&M) for each footprint. Table 3 shows estimates of installed costs for each footprint assuming a cost of between $1-1.30/Wdc. This range accounts for the varying cost of materials used to construct solar panels. Area A would cost between $36,432,800 and $47,362,640. Area B would cost between $6,103,600 and $7,934,680. Operations and maintenance would provide ongoing costs for both areas. This might include routine inspections and repairs. Area A would cost approximately $473,626 each year. Area B would cost approximately $79,347 annually. Installed costs do not include the fees and installation costs for interconnection to transmission lines, nor costs to establish a microgrid connection to specific facilities.

	Size (acres)	Estimated Capacity (kW)	Installed Costs ($1/Wdc)	Installed Costs ($1.30/Wdc)	Annual O&M Costs
Area A	60	36,433	$36,432,800	$47,362,640	$473,626
Area B	10	6,104	$6,103,600	$7,934,680	$79,347
*Based on the System Advisor Model (SAM) https://sam.nrel.gov/.					
*Assumes that the installed costs= 1-1.30$/Wdc (includes range for environmental materials management) and annual O&M cost =$13/kW-year.					

Table 3: Estimated costs for solar project Area A and B.

Summary

Table 4 provides a summary of considerations for both project areas. The information below includes project size, estimated capacity, generation surplus, CO2 reduction, distance to transmission and total project costs. The two solar project areas would be large enough to produce more than enough electricity to offset the energy demands of nearby tribal government offices and businesses. Battery storage could be utilized to capture excess electricity produced.

Consideration	**Area A –** area located south of Quapaw.	**Area B** – area located south of the Pow Wow grounds.
Project Size	60-acres	10-acres
Estimated Capacity	Estimated 36,433kW capacity Annual 55,171,623kWh capacity	Estimated 6,104kW capacity Annual 9,242,992kWh capacity
Estimated Generation Surplus	55,171,623kWh	9,242,992kWh
Estimate of Metric Tons of CO2 Equivalent Reductions*	38,360	6,394
Distance to Nearest Transmission	1.4 miles	3.8 miles
Project Costs	$36,432,800 – $47,362,640 – Installed Costs $473,626 – Annual O&M	$6,103,600 – $7,934,680 – Installed Costs $79,347 – Annual O&M
*Based on EPA's Greenhouse Gas Equivalencies Calculator https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator		

Table 4: Summary of considerations for project footprints.

As a next step for solar development, Quapaw Nation could consider a phase approach and work with the City of Quapaw to consider options for partnership with a utility or formation of a Tribal Utility to fund and manage power production and distribution. More information about solar project ownership and development processes is described in the solar development approaches section below.

Solar Development Approaches

Quapaw Nation partners are considering various options for how to proceed with developing a solar project at one of the two areas under consideration. The information below includes a list of key assumptions about the options for proceeding, followed by an explanation of typical solar project development and ownership models, and a solar development decision tree graphic that clarifies where decisions are needed and what the options are.

Options and Assumptions

As the Quapaw Nation considers development, financing and power ownership options for a solar project, the following factors described below and highlighted in the decision tree (Appendix A) will be important to consider.

- Partnership options – the Quapaw Nation could partner with Liberty Utilities, other solar developers, or members of the business community to develop a solar project.
- Project ownership options – Third-party ownership or direct ownership could be considered.
- Project models – Depending on ownership, a utility-sponsored model, non-profit model, or Special Purpose Entity model could be considered.
- Funding mechanisms – Funding can be obtained through partnerships or federal or state funding opportunities.

Solar Project Development and Ownership Models

Quapaw Nation partners could pursue one of several potential ownership and development models to support a community solar project.

Third-party Ownership

Third-party financing predominately occurs in two forms: solar leases and power purchase agreements (PPAs). In the lease model, a customer signs a contract with an installer/developer and pays for the use of a solar system over a specified period, rather than paying for the power generated. In a PPA model, the solar energy system offsets the customer's electric utility bill, and the developer sells the power generated to the customer at a fixed rate that is typically lower than the local utility. In both cases, a third-party owns, operates, and maintains the photovoltaic system.

Possible Third-Party Owners:

- Liberty Utilities supplies most of the power that the Quapaw Nation currently uses. There is precedent for Liberty to develop a community solar project on a remediated Superfund site and they may consider partnering with the Quapaw Nation.
- If Liberty is not interested in partnering with the Quapaw Nation, another third party such as a solar developer might be interested in a partnership. If not, the Quapaw Nation could pursue other options including a non-profit model or Special Purpose Entity (direct ownership models).

Direct Ownership

In the direct ownership model, subscribers sign an ownership agreement and make an up-front payment to purchase solar panels from the utility or third-party developer. The third-party or the utility will construct and operate the solar panel and, in some cases, provide renewable energy credits to subscribers. If the plant is operated by a third party, this operator provides membership information to the utility to facilitate subscriber bill crediting. The utility in turn provides electricity to subscribers of the system and subscribers receive a credit against their utility bill based on their panels' energy production.

Possible Partners:

- A Special Purpose Entity is formed when individual investors join in a business enterprise to develop a community solar project. Members of the business community could form and run a solar utility business that would provide energy to the Quapaw Nation. Investors must negotiate contracts as well as the legal and financial hurdles of setting up a business and raising capital. Many entities pursuing community solar are organized by another existing business entity with legal and financial experience.
- If members of the business community are willing to contribute to a solar project, the Quapaw Nation could consider using a non-profit "buy a brick" model. A non-profit model involves a non-profit organization partnering with businesses or citizens to develop solar projects. Supporters of the non-profit provide tax-deductible donations. While they do not share directly in the benefits of the solar installation, they share indirectly by lowering energy costs for their favored non-profit and demonstrating environmental leadership. If members of the business community are not willing to partner, the Quapaw Nation could pursue other options including State and Federal funding and third-party ownership.

Federal and State Funding

Federal and State funding is available to help finance direct ownership of a solar project. Federal and State tax incentives can be used to support solar projects. Additional detail can be found on the Database of State Incentives for Renewables & Efficiency (DSIRE) located at www.dsireusa.org/.

Conclusion

In 2024, SRP partnered with the Quapaw Nation to assess opportunities for solar reuse at the Tar Creek Superfund Site in Ottawa County, Oklahoma. This solar reuse assessment is an update to a 2019 Solar Reuse Assessment completed in partnership with the US EPA Region 6, Quapaw Nation, and the GRDA. SRP worked with the Quapaw Nation to assess tribal business energy usage, evaluate cleanup and remediation status and analyze electric transmission infrastructure to identify areas with potential for solar development near tribal offices and businesses to offset tribal energy usage. SRP identified two project areas that could accommodate a solar PV array in proximity to high electricity usage areas (Quapaw and Pow Wow Grounds/Administration Building). Solar development in these footprints could provide enough energy to offset electricity use in nearby areas. Battery storage could be utilized to capture excess electricity produced. Quapaw Nation could pursue solar development in partnership with the City of Quapaw, solar developers or members of the business community, and with third-party or direct ownership. Multiple project models are available for solar development, including a utility-sponsored model, non-profit model or Special Purpose Entity. Funding can be attained through partnerships or federal or state funding opportunities. These potential solar development options can support Quapaw Nation and partners in pursuing energy sovereignty through community solar investments.

Contacts

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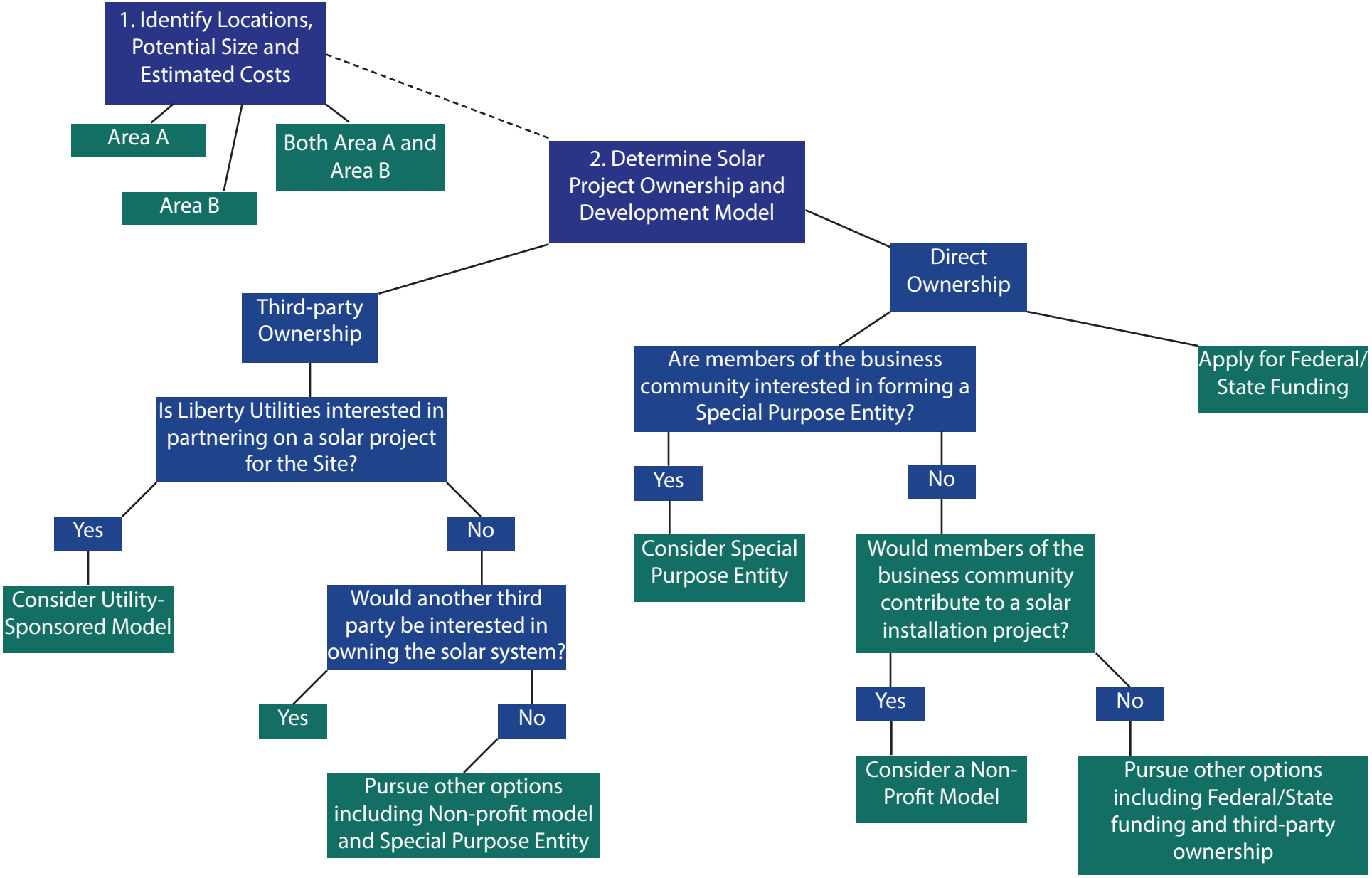
Appendix A: Decision Tree



Appendix B: Case Study

CASE STUDY

Community Solar Farm
Oronogo-Duenweg Mining Belt, Southwest Missouri

At the Oronogo-Duenweg Mining Belt site, EPA has cleaned up about 2,500 residential properties, and excavated mine waste from 4,500 acres around Joplin, Missouri. Cleanup activities have resulted in about 4,000 acres that are ready for reuse.

In 2021, a 60-acre part of the site located in the community of Prosperity became home to southwest Missouri's first solar renewable energy generation facility. Liberty Utilities developed a 2.25 megawatt (MW) solar project at a remediated former mine waste area. The solar panels will be able to generate enough electricity to power 400 homes if the pilot is successful.

Liberty has developed the solar farm based on a community solar model. Customers sign up for Liberty's Solar Subscription program and purchase blocks of solar power at a fixed rate over a period of time. This innovative approach allows a wide range of potential customers to invest in renewable energy without installing the panels or necessarily owning the property. The subscription program is open for both residential and commercial customers. Liberty has plans in place to develop several other 2 to 5 MW solar projects, with a goal of generating about 30 MW in the southwest Missouri region.