

SANDIA REPORT

SAND2023-08664

Printed August 2023



Sandia
National
Laboratories

Illuminating Common Ground: Success Factors for Contiguous US Tribal Solar Energy Development

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ABSTRACT

Tribal energy development is a complex multi-faceted topic. The objective of this work is to identify common themes across tribal solar energy deployment projects, focusing specifically on lessons learned and recommendations. Identifying these commonalities and learning from the experiences of tribes that have embarked in energy development efforts can help to inform the development of future tribal solar energy projects. A thematic qualitative analysis approach was used to analyze project reports and presentations for 41 tribal solar deployment projects (only within the contiguous United States) funded by the Office of Indian Energy Policy and Programs, applying a framework of success factors developed from the literature. The results of the qualitative analysis are described in four discrete parts: comprehensive and inclusive planning, fostering partnerships and collaboration, building capacity, and exercising and advancing tribal sovereignty. Each of the overarching themes inform recommendations for tribes to promote the success of solar projects.

ACKNOWLEDGEMENTS

I would like to express my gratitude to the members of my project committee, Gabe Chan, Matthew Grimley, and Sandra Begay, for their invaluable guidance and input throughout the paper-writing process. I would also like to acknowledge the Department of Energy Office of Indian Energy Policy and Programs and Sandia National Laboratories for providing support for the tribal energy internship program that made this work possible. I would like to thank Deborah Levison and my classmates from the Professional Paper Seminar for their support and feedback throughout the semester. Finally, I want to thank my parents and my partner for their unwavering love, support, and encouragement over the years.

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ACRONYMS AND TERMS

Acronym/Term	Definition
DOE	Department of Energy
EBCI	Eastern Band of Cherokee Indians
EERE	Office of Energy Efficiency and Renewable Energy
IE	Office of Indian Energy Policy and Programs
IRB	Institutional Review Board
ITC	Investment Tax Credit
O&M	Operations and maintenance
PPA	Power Purchase Agreement
PTC	Production Tax Credit
PV	Photovoltaics
US	United States

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1. INTRODUCTION

Imagine that it's the 1930s and you live in the rural United States. Electricians have just connected your house to electricity, and you flip the switch to turn on your kitchen light for the very first time. The Rural Electrification Act of 1936 granted many American households access to electricity, and with it came amenities many now consider essentials, such as heating and refrigeration. However, fast forward almost 100 years to 2023 and there are still households in this country without access to electricity. For some families, like those in the Navajo Nation where there are still as many as 15,000 households without power, flipping a light switch can still be a life-changing experience made possible by installation of small-scale solar systems and community-level efforts to bring grid access to remote homes.

There are numerous similar stories across U.S. Indian Country (tribal lands), where solar energy development has made a positive impact. For example, the Blue Lake Rancheria tribe proved themselves as leaders in the energy resiliency space by utilizing their solar microgrid to provide emergency response services to over 10,000 in their county during a day-long public safety power shutoff (Wilson 2020). For the St. Regis Mohawk Tribe, solar development combined with energy efficiency measures have helped to provide affordable energy to low-income families and enabled the tribe to work towards their net-zero goals. The reasons why tribes may choose to pursue solar energy development are as varied and diverse as each of the tribes themselves; there are 574 federally recognized tribes in the United States, each with their own unique history, experience, challenges, strengths, and goals related to energy.

Across the country, tribes are making immense progress in utilizing renewable resources that benefit their communities, enhance tribal sovereignty, and empower tribes to restore economies that were decimated by colonization. Along the way, tribes encounter and are overcoming many barriers. There is a growing body of literature that identifies success factors and offers recommendations to address these barriers. To help inform future tribal solar project development, this analysis aims to build on the literature by adding lessons learned from projects funded by the Department of Energy (DOE) Office of Indian Energy (IE) for the lower 48 states and does not include Alaska Native projects.

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2. BACKGROUND

2.1. Energy Challenges

Many tribal communities experience heightened rates of poverty, unemployment, and lack of economic development opportunities. Consequently, tribal households have higher levels of energy burden than the national median, meaning that they spend a disproportionate amount of their income on energy expenses (such as heating and electricity). It is estimated that 36% of Native American households experience high energy burden, spending over 6% of annual income on energy expenses [7]. While programs do exist that can aid in alleviating energy burden, such as the Low-Income Home Energy Assistance Program or the Weatherization Assistance Program, they are not able to serve all energy-burdened households eligible for assistance and can only do so much. For example, tribal households receiving assistance from Minnesota's Energy Assistance Program had the highest levels of energy burden in the state both prior to (15.4%) and after (6.6%) participation in the program [9]. High energy burden can have detrimental effects to physical and mental health, and it is exacerbated by poorly insulated, energy inefficient housing conditions.

Some tribal households struggle to gain access to electricity in the first place. A study in 2000 found that 14.2% of tribal households on reservations lacked access to electricity, compared to 1.4% of US households as a whole [8]. In one example on the Navajo Nation, 30% of households are still unelectrified, making up 75% of the country's total households without electricity [1]. There is a clear disparity in electrification of tribal households. During the first half of the 20th century when the Rural Electrification Act initially gave rural communities access to electricity, many tribal homes were left out. Today, it costs the Navajo Tribal Utility Authority as much as \$40,000 to connect a single home to electricity due to the distance some homes are to the nearest power line. This situation is because the reservation spans 27,000 square miles and some residences can be extremely remote [2]. Uneven distribution of electrification translates to unequal access to amenities that many would consider basic necessities, such as refrigeration, home cooling and heating, artificial lighting, and internet access, which can have broader impacts on health and education.

With the effects of climate change, tribes are also increasingly beginning to experience challenges related to energy resilience and reliability. Some tribes are facing increased threats from earthquakes, floods, and wildfires, as well as outages due to public safety power shutoffs. For example, the Quinault Indian Nation in Washington was forced to make the difficult decision to relocate the entire village of Taholah to higher ground in response to sea level rise, storm surge, and the threat of tsunamis. Additionally, the Rincon San Luiseño Band of Mission Indians experienced long-duration wildfire-related power outages totaling over 90 hours, disrupting essential services such as tribal police and emergency management [16].

2.2. Tribal Solar Energy Development

As the energy transition continues, tribes are increasingly turning to renewable energy development, including solar photovoltaics, as a way to alleviate energy burden or address other challenges, as well as accomplishing community goals of sustainability, sovereignty, and economic development. Solar projects have provided a range of direct benefits, including electrification of off-grid homes, reduction of energy costs for tribal buildings and residents, revenue generation, and resiliency. Energy development also has the potential to provide a number of indirect benefits, such as economic development, and serves as a pathway to advancing energy sovereignty and empowering communities to take control of their own energy resources and economies.

Solar installations range in size from several small rooftop panels on a residence, all the way up to larger, stand-alone projects, falling broadly into three main categories: facility, community, and commercial scale [13]. Residential- or facility-scale solar often consists of a single building system (either roof-mounted or ground-mounted) being utilized to provide or offset energy use for that building. In contrast to facility-scale, community-scale projects are larger, often spanning multiple buildings or locations in the community. Finally, commercial-scale or utility-scale solar projects – the largest type of projects – are often ground-mounted installations used to generate revenue by selling the electricity through power purchase agreements (PPA).

The DOE Office of Indian Energy Policy & Programs (IE) has provided funding, technical assistance, educational resources (e.g., webinars, workshops, other online resources, and support for student internships), financial analysis, and strategic energy planning for tribal renewable energy projects. Since 2010, they have contributed over \$120 million in funding for over 200 tribal energy projects, helping to deploy over 40 megawatts (MW) of energy generation across the country [14]. Information on each of these projects, along with presentations and final reports, are compiled within the Tribal Energy Projects Database on the Office of Indian Energy’s website. These reports contain a wealth of information on individual tribes’ experiences and lessons learned through developing a renewable energy projects. IE also hosts an annual Program Review, which provides a space for tribes to share success stories and lessons learned through their project development experiences.

3. RESEARCH OBJECTIVES

To help inform future tribal solar energy project development, this paper supplements recommendations from the literature with lessons learned while executing Office of Indian Energy funded projects (contiguous US only). In this work, the following research objectives are accomplished:

- Establish a framework of success factors from a review of relevant literature,
- Use qualitative thematic analysis to apply the framework to a set of reports and presentations from solar projects funded by the Office of Indian Energy, and
- Identify commonalities in success factors between the projects and literature and use them to inform recommendations on actions tribes may take to foster the success of tribal solar deployment efforts.

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4. A FRAMEWORK FOR SUCCESS

As the body of work that identifies barriers to tribal renewable energy development grows, so does the work that identifies policy recommendations and strategies to overcome these barriers [11]. However, much of this work is focused on audiences other than tribes, such as the federal government, state governments and agencies, and electric utilities. A smaller subset of the literature discusses the elements of successful tribal energy projects and strategies that tribes themselves may employ to overcome barriers and foster the success of projects. From these, four recurring success factors emerged: (1) Comprehensive and Inclusive Planning, (2) Exercising and Advancing Tribal Sovereignty, (3) Fostering Partnerships and Collaboration, and (4) Building Capacity. While more elements of success certainly exist, these four categories broadly encompass many of the recommendations from literature.

4.1. Comprehensive & Inclusive Planning

Strategic energy planning is described by the Office of Indian Energy as “a collaborative visioning exercise in which tribal communities identify their energy resources, explore their options, and map out a path to the energy future they envision for themselves.” [15]. IE highlights the benefits of developing a strategic energy plan, including economic, community, and environmental benefits, and has outlined the strategic energy planning process as a nine-step cycle (Figure 1) that may be used iteratively to re-evaluate and update the plan over time [6].

The first step in the process involves identifying and convening stakeholders, such as tribal leadership and staff, community members and organizations, local energy users, representatives from utilities, and regional inter-tribal organizations, as well as state or regional-level energy administrators. Next, establishing a leadership team to drive the energy planning process and serve as champions of the planning efforts is key. Utilizing community and stakeholder input to develop an energy vision and identify the community’s top aspirations and how to achieve them is also important. An assessment of the community’s energy environment is necessary in this process, as “an effective strategic plan needs to build upon what has already been accomplished” [6]. This includes data gathering and analysis for the community’s current and forecasted energy use, understanding the energy landscape of relevant external jurisdictions (at the state, regional, and utility scale), and thinking about the community’s own strengths, weaknesses, opportunities, and threats.

The following step in the process is to develop specific energy goals (preferably SMART goals: Specific, Measurable, Actionable, Realistic, and Time-Bound) and define the scope of the energy plan. Prioritizing the strategies with the highest impact and cost-effectiveness is key, as is identifying fund financing options. The final steps are to create a formally adopted, public document summarizing the energy plan and treat it as a “living document” that evolves as the tribe’s energy landscape evolves.

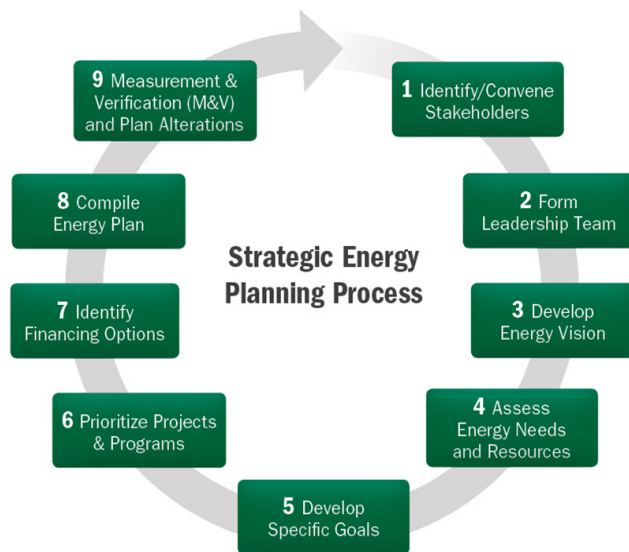


Figure 1. START Strategic Energy Planning Process [15]

Findings of an expert elicitation by Jones and Necefer [11] indicate that strategic energy planning plays an important role in the success of tribal renewable energy development and is related to community vision, stakeholder buy-in, and cultural acceptance. Specifically, Jones and Necefer discuss the impact that culture can have on community preferences and perceptions of renewable energy development, as well as highlight the importance of community input in energy decision-making. They note that developing a “comprehensive strategic energy plan that engages tribal citizens and includes cultural values into a larger, long-term energy vision can identify appropriate pathways for renewable energy development on a tribe’s land” and “offer a proactive opportunity for tribes to access the sentiments of the community regarding how energy should play a role in the tribe’s future.”

Beshilas et al. [4] highlights the benefits that long-term planning initiatives can have for tribes, “ensuring that broad stakeholder input is solicited (improving Tribal buy-in and knowledge) and identifying actions to achieve the desired goals (providing structure that supports long-term continuity)”. In a case study of the Eastern Band of Cherokee Indians’ 705-kW solar project, the authors describe the tribe’s journey through the energy planning and project development process. This included developing a long-term energy vision, establishing a project team, Energy Committee, and energy coordinator position, and completing a strategic energy plan. “This stepwise, deliberate process, with engagement of key decision makers across Tribal government and economic operations, was critical...”

Through a survey of tribal energy staff and leaders, Brookshire and Kaza [5] found that tribes that had developed formal energy plans were more likely to have energy-related policies and departments in place than tribes without formal energy plans and were also more likely to engage in renewable energy development. They note that “the central characteristic of tribal planning efforts is that they emphasize community control to overcome the dysfunctions of externally imposed planning and policy solutions.” In addition to highlighting strategic energy planning as a tool for creating an energy roadmap in alignment with community goals, the authors also discuss how energy planning can advance sustainable energy development, self-sufficiency, and sovereignty.

4.2. Fostering Partnerships & Collaboration

A commonly cited barrier to tribal renewable energy development is the difficulty of securing funding, especially for large, capital-intensive projects ([3]; [5]; [11]). Additionally, their tax-exempt status as sovereign nations have prevented Tribes from directly taking advantage of renewable energy tax credits, such as the Investment Tax Credit (ITC) and the Production Tax Credit (PTC)¹. As a result, tribes often must rely on partnerships with non-tribal entities and investors for energy development projects. Collaboration with outside entities that provide financial and technical assistance, like the Office of Indian Energy, national laboratories, nonprofits, and more are common in tribal energy projects. However, Jones and Necefer's expert elicitation also found that certain aspects of partnerships with outside entities, such as waivers of sovereign immunity, misalignment of goals, and mutual distrust can impede tribal energy development.

When tribes are served by multiple electric utilities, as some are, it can introduce additional complexity to energy planning and the energy project development process ([4]; [9]). A single project may be required to adhere to multiple differing net-metering and interconnection policies, and the tribe may need to engage in negotiations with multiple utilities, which requires additional time and resources. The fragmented nature of utility service territories and tribal lands is also reflective of some tribes' relationships with utilities. In one example, interviews with tribal members from Minnesota revealed frustrations with the lack of participatory planning or tribal representation on cooperative utility boards, miscommunication and delays that hindered project development, high costs associated with things like security deposits and reconnection fees, and discriminatory disconnection practices [9].

Jones and Necefer highlight the need for "improved understanding and shared knowledge" between tribes and outside partners and entities. They also mention the value of working collaboratively with states and utilities to create agreements beneficial to tribal energy development, such as renewable energy portfolio standards. Beshilas et al. extensively discuss the opportunities involved in engaging and working collaboratively with utilities, elected and appointed officials, and state regulatory agencies. For example, in cases where tribal energy development is hindered by unclear or nonexistent interconnection policies, the authors suggest that "tribes can work with their serving utility to explore broad policy change or project-specific solutions to interconnection issues." Early engagement with utilities and outreach from tribes to energy decision-makers providing Tribal perspectives are also discussed. "Regular communication between Tribes and decision makers over long periods of time can serve as a foundation for successful relationships." Similarly, Grimley, LaDuke, and Fairbanks highlight collaboration with utilities, funders, and developers. "One interviewee mentioned that utilities can be and have been the Tribal governments' greatest partners – but only if they are and have been ready to cooperate."

Intertribal collaboration was proposed as a promising pathway to success that can help tribes to overcome gaps in capacity and build stronger partnerships: "Shared knowledge and capacity for development between tribes is a valuable opportunity that should be explored as a pathway for addressing identified deficits." Beshilas et al. also advocate for engagement with intertribal organizations and advocacy groups, noting that "this knowledge-sharing reduces capacity barriers to solar project development by unraveling the complexity of the energy policy landscape."

¹ A recent development that may mitigate this barrier is the recent Inflation Reduction Act of 2022, which has enabled tax-exempt entities, including tribes to directly monetize renewable energy tax credits like the ITC and the PTC.

4.3. Building Capacity

For many tribes, there also exist gaps in internal technical and administrative capacity that impede energy development ([11]; [5]; [4]). Often, there is no “point-person” or a team of staff to devote their full attention to energy issues and take charge of energy planning or projects. This can be due to a variety of reasons, such as staff turnover, lack of technical experience, or insufficient financial resources. As a result, energy work is often undertaken by tribal staff in other departments, such as economic development or environmental offices, who may not have sufficient time, expertise, or resources to make fully informed decisions or effectively engage in the time-consuming and often complex process of developing an energy project.

Turnover in tribal staff and leadership can also lead to instability throughout the course of a project. As priorities shift, additional time and resources are devoted to familiarizing newcomers with ongoing energy work, and support from newly elected officials must be obtained. This instability may discourage outside private developers from partnering with tribes [18]. Jones and Necefer also discuss the occasionally detrimental impact of certain tribal governance structures and leadership turnover in project development.

Capacity building and workforce development were prominent discussion topics in the literature. Interviewees in Jones and Necefer’s expert elicitation discussed development of smaller facility- and community-scale projects as an opportunity for tribes to take steps towards building capacity, as the upfront costs and barriers are often smaller. Jones and Necefer identified internal capacity as one of the most important factors for success and emphasized the importance of education and capacity building at all levels, including tribal staff, tribal leadership, and all age levels of the community.

Beshilas et al. similarly advocate for tribal members to work towards holding elected or appointed positions on energy decision-making boards and establishing an energy-related position to “establish some measure of continuity and institutional knowledge”. They also note that revenue and cost savings from energy projects can be reinvested back into the community to fund energy staff positions, energy education efforts, or even future projects. In their case study on the Eastern Band of Cherokee Indians (EBCI), they noted that “the keys to solar project development success for EBCI were in making a long-term commitment to environmental sustainability, investing in internal capacity, and executing increasingly complicated energy projects.”

Grimley, LaDuke, and Fairbanks also discuss the importance of energy education at all levels (from children to elders), workforce development, and capacity building. They also touch on how tribal members have been able to develop job skills through participating in tribal solar installation, as well as other related opportunities for tribes, such as building on existing assets like Tribal Employee Rights Office/Ordinance (TERO) programs and tribal colleges. “Despite shortages in staff capacity, it was clear in interviews that knowledge and awareness of how to implement clean energy projects was growing across the Reservations.”

4.4. Exercising & Advancing Tribal Sovereignty

Like many tribal lands, the Agua Caliente Band of Cahuilla Indians reservation is “checkerboarded”, meaning that tribally owned parcels of land are interspersed with non-tribal lands. This mixed land ownership, a result of 19th and 20th century federal land policies like the General Allotment Act of 1887 (the Dawes Act), presents unique challenges for tribal energy development and has led to disputes over land use and tribal sovereignty. Agua Caliente’s reservation coincides with the City of Palm Springs, which in the 1960s and 70s attempted to exercise control over tribal lands in the downtown area as the city and demand for land grew. However, the tribe was successful in asserting

their right as a sovereign nation to control the land within their jurisdiction. In 1977 Agua Caliente entered into a land use agreement with the City, recognizing its “powers of self-determination to adopt policies to achieve the highest and best use of Agua Caliente Indian lands, including but not limited to zoning and development thereof” [10]. The Tribe has since gone on to form a lasting partnership with the City of Palm Springs and now own and operate multiple major developments on tribal land, including facility scale solar installations ([4]; [10]). They serve as a success story in exercising tribal sovereignty, working creatively to overcome land barriers, and effectively collaborating with neighboring jurisdictions.

Jones and Necefer explore exertion of sovereign power over land, resources, and governance as a pathway for successful tribal renewable energy development. Respondents in their expert elicitation discussed tribal sovereignty as a “motivation and catalyst for future renewable energy development”, as it promotes “goals of energy self-sufficiency and independence, environmental sustainability, economic development, and community resiliency.” One example is the implementation of tribal policy supporting energy development, such as tribal renewable energy portfolio standards, regulations, or incentives. Similarly, Beshilas et al. discuss the use of tribal laws and regulations related to third-party ownership, interconnection, and land-use planning as ways for tribes to exercise sovereignty in support of renewable energy development.

Beshilas et al. note that “tribal sovereignty provides several tools that Tribes can wield to better support their communities’ energy goals.” One such tool discussed was the formation of tribally owned utilities or utility commissions. “Tribal utilities formed under Tribal law that serve customers on Tribal lands are not regulated by state regulatory commissions”. Thus, utility formation can serve as a pathway for tribes to have greater control over utility policies that affect energy development. In their report on electrification of Ojibwe nations in Minnesota, Grimley, LaDuke, and Fairbanks also discuss tribal utility formation: “To have sovereignty over their energy issues, most Ojibwe nations are considering or in the process of forming their own utilities commissions, energy partnerships, enterprises, and utilities.” Multiple interviewees said that “regulating rates or taking over infrastructure might be their only recourse to meeting their Tribal goals on cost, reliability, and climate change adaptation and mitigation.”

In one case study, Beshilas et al. highlighted how the Saginaw Chippewa Indian Tribe of Michigan utilized their right as a sovereign entity to form their own Tribal Electric Authority, build their own substation, and participate in the Midcontinent Independent System Operator (MISO) wholesale market. This has not only enabled them to make the electrical distribution upgrades needed to construct an expansion to their casino and hotel, but also opened up other new economic development opportunities: “There will be a lot of demand in the MISO region for renewable energy projects, energy services that can be provided by energy storage, and other market projects related to energy”.

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5. DATA & METHODS

Through thematic qualitative data analysis, this research project aims to identify commonalities in success factors among tribal solar deployment projects. The data utilized in the analysis includes final project reports from a subset of Office of Indian Energy-funded projects, as well as transcriptions of recorded presentations from the 2020 and 2021 Office of Indian Energy Program Reviews. Both the final reports and the presentations are available publicly online; the report documents can be found in the Tribal Energy Projects Database on IE's website, while the presentation recordings can be viewed on IE's YouTube channel. Within the scope of this analysis, only solar projects within the contiguous United States are included. The final set of project reports and presentations included in the analysis spans 41 solar deployment projects developed by 34 different tribes. Overall, 30 project reports and 25 presentations were analyzed. Projects included in the analysis vary in size, ranging from residential-scale solar installations to larger community-scale arrays.

The qualitative analysis was executed by utilizing Braun and Clarke's six-step approach to thematic analysis, as outlined by Kiger and Varpio (2020), who describe it as an "appropriate and powerful method to use when seeking to understand a set of experiences, thoughts, or behaviors across a dataset" [12]. While thematic analysis shares similarities with the grounded theory method, it is situated more centrally on a spectrum between exclusively descriptive analysis methods and highly interpretive methods. As read through reports and listened to the presentations, identified common barriers are referred to as a "code." (See Appendix B for a listing of the codes). Through an iterative process of identifying codes and constructing themes, a performed thematic analysis using Atlas.ti 23 software, which enabled users to describe and make connections across a dataset, developing broader interpretations of the data with the flexibility to use either an inductive or deductive approach. The present analysis was completed utilizing a mostly deductive approach, meaning that themes were guided by the framework of success factors developed from the literature.

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6. RESULTS

Starting with the four components of the framework as overarching themes, 42 different codes were generated during the thematic analysis process (see Appendix B for the full codebook). Table 1 below summarizes the number of times codes from each theme were applied to excerpts from a project report or presentation transcription. The following sections provide results in further detail.

Table 1. Code Occurrences by Theme

Comprehensive & Inclusive Planning	Fostering Partnerships & Collaboration	Building Capacity	Exercising & Advancing Tribal Sovereignty
165	138	113	71

6.1. Comprehensive & Inclusive Planning

Strategic Energy Plans & Visions: Overall, 14 of the 34 tribes included in the analysis mentioned having strategic energy plans or energy visions in place at the time of project development, often multiple years prior to project inception. Some tribes established dedicated energy plans, while others incorporated energy into other areas of planning, such as economic development plans or resiliency plans. Several mentioned receiving assistance from DOE, who provide technical assistance through Sandia National Laboratories and the National Renewable Energy Laboratory. Laboratory staff and their subcontractors facilitate strategic planning activities.

Through these plans and visions, tribes set energy goals and commitments in alignment with their community's values and needs relating not just to energy development, but also to sustainability, environmental stewardship, energy efficiency, preservation of culture, self-sufficiency, economic development, and more. Some of the goals and objectives mentioned throughout the projects included:

- utilizing clean or renewable energy for a percentage of the Tribe's energy needs,
- moving toward energy independence and decreasing reliance on fossil fuels and grid-supplied electricity,
- incorporating renewable energy and green building practices into current and future development,
- establishing the tribe's current energy usage,
- identifying viable options and opportunities for renewable energy and energy efficiency measures,
- assessing costs and benefits of options, and
- reducing increasing energy expenses.

Almost all tribes that mentioned having a strategic plan or vision described the project as a step toward achieving their outlined goals and objectives. Even tribes that did not discuss having a formal energy plan or vision often described the project as a way to further their goals and overarching mission. Several tribes indicated having completed multiple iterations of strategic planning or updated previous plans, which aligns with the circular process recommended by IE, in which strategic plans serve as living documents and evolve over time. In one example, the tribe was heavily impacted by a natural disaster, which highlighted gaps in their emergency response and energy plans, and ultimately led to the tribe revisiting these plans.

Thorough Research & Analysis: The importance of informed decision-making was emphasized throughout the projects. One project report emphasized: “Plan, plan, plan - be well-prepared before putting together the grant application”. Another report noted, “If a tribe is considering alternative energy projects, it would seem that the best direction is a complete planning process that allows for consideration of a wide range of potentials”. Energy audits, feasibility studies, geotechnical analysis, and site-by-site analyses of energy consumption and possible production were all listed as tools to evaluate project sizes and locations that would yield the greatest benefit to the tribe. There were several recommendations to start energy development with the “lowest-hanging fruit”, or smaller projects that are easiest to implement and provide immediate benefit.

Many also discussed maximizing project benefits. “One of the most important components of the project was to utilize funds for installations that would provide a substantial net benefit to the Tribe”. Some tribes supplemented their projects with energy efficiency measures, focusing on weatherization, upgrading lighting, water heaters, and designing newly constructed buildings with energy savings and energy efficiency in mind. Sizing projects in accordance with net metering policies was also common: “The Tribe carefully sized each installation so that systems were careful not to overproduce. Unfavorable net metering could result in a poor return on purchase of the power under a power purchase agreement by the utilities.”

The importance of planning for the future life of the project was underscored. One tribe reflected on how they might have improved in this regard: “Overall building capacity and the future effect of installations was not researched properly and could limit the Tribe when selecting new renewable energy projects.” Additionally, the challenges associated with arranging post-construction operations and maintenance (O&M), and the importance of planning for it, was a common topic. Several tribes mentioned difficulties funding O&M activities and how the life and effectiveness of the project may be negatively impacted without it. One tribe recommended that a portion of project revenue be allocated towards paying for O&M training of tribal employees and paying for future O&M expenses. “As a component of the goal to look towards the future for this project’s outcome and future projects, a work-force development component was built into the project.”

Despite extensive planning efforts, however, numerous tribes stressed the importance of being prepared to deal with unanticipated obstacles and delays during project development: “We learned to be prepared for the unexpected, such as weather-caused delays, or for small setbacks such as delays in procurement for equipment.” Some causes of delays discussed throughout the projects included lengthy review and approval processes by outside entities, weather, equipment procurement, construction complications, and scheduling conflicts. Planning for staff turnover was also discussed, as in some cases turnover during the project posed challenges, caused delays, or even brought the project to a standstill. Several of the projects in the Midwest region experienced limited construction seasons due to snow, and some tribes noted the need to plan for snow removal to prevent impacts to production during the winter months. Many of the more recent projects also experienced complications at various stages of project development due to the COVID-19 pandemic, including delays, staffing shortages, and supply chain issues, and several mentioned that they were unable to incorporate workforce development training into their projects as originally planned. Overall, flexibility was commonly discussed as a key to success.

Community Engagement: The importance of early and on-going community engagement and information dissemination, as well as transparent decision-making and project development process, was a common theme across projects. In some cases, community input during the early phases of project development was key in making decisions about things like project size and scope. Some also had an emphasis on planning in alignment with community values and culture, underscoring the

need to “work with communities in a culturally-appropriate manner” and to ensure that energy projects have “the cultural values of the tribe in mind”. The value of including local knowledge throughout the project development process, in this case through an advisory group, was also highlighted: “The group provided local input and knowledge which was very valuable in that the provided information which kept the project from problems which may not have been apparent in maps of building records...The group helped keep the project on schedule”. Advisory groups, community discussion, and collaborative meetings with community representatives were all discussed as ways of eliciting community input on tribal energy decisions. One noted, “We had a two-day collaborative meeting with department heads, leadership, and community representatives”.

Similarly, the support and buy-in of not only tribal leadership, but also the community as a whole was cited numerous times as essential to success. “The very most important thing with any of these projects is for community support”. Several noted that “buy-in and commitment are not automatic” and stressed the need for education on the project impacts and benefits. In one presentation, there was a comment that “While we all agree that solar energy is terrific, there were some challenges with different members who were disenfranchised with the cutting down of trees or with the change in the view shed with the solar panels, so we had to really do a lot of education.”

Several tribes reflected that they could have improved on community engagement efforts: “The Working Group did not engage Tribal members early enough to explain the benefits of the installations or the decision making behind certain installations.” Another said, “Although tribal members were aware of the project and the potential benefits of the project, the group could have provided greater understanding of how those benefits would improve the situation of the Tribe vis-a-vis the environment and its own economic agenda.” Improved engagement and communication of impacts and benefits earlier in the process would have helped garner more support and improve community members’ understanding of the project benefits and impacts. One recommendation was to “communicate with your tribal leaders, department heads, and community members to promote the positive outcomes of your solar installation.”

Maintaining Momentum & Planning for the Future: There were multiple recommendations to keep momentum from the project going by continuing to seek funding opportunities in an on-going manner. “Generally, it can be said that seeking funding opportunities are a critical element and essential element in process success.” Another tribe worked to complete pre-feasibility studies in order to start constructing a list of “shovel-ready” projects to pursue as funding becomes available. In addition to involving community members prior to and during project development, the benefits of continually engaging with the community on future opportunities and projects, and how this can help to maintain interest and commitment and keep momentum going for future energy development efforts, were discussed. Radio announcements, newspapers, postcards, social media, and informational meetings were all avenues of information dissemination utilized throughout the projects. “Don’t forget old school use of flyers and newsletters”, one emphasized. Seeing firsthand the success and benefits of the project after completion often garnered increased interest and support from the community. One of the reports noted that “response from the community has been positive overall with realized monthly savings and pride to be part of a program helping the environment.”

6.2. Fostering Partnerships & Collaboration

The Value of Partnerships: Throughout the projects, the value of partnerships was frequently highlighted, particularly for tribes with minimal prior experience with energy project development. Some tribes formed financial partnerships to help cover the cost share and take advantage of tax

credits. In other cases, project partners helped to fill gaps in expertise, and the importance of selecting experienced and committed contractors with the right skill sets was discussed multiple times. Several tribes emphasized how invaluable their contractors were in filling in gaps in capabilities and experience, and the role that their contractors played in the success of the project. One remarked, “We cannot underestimate the value of a project manager for us on this project... We did not have any experience in this arena prior to the project. Hiring someone who did have that experience, and recently with a local tribe proved invaluable.”

GRID Alternatives, a nonprofit organization specializing in solar installation and job training, was a common project partner: “The collaboration with the GRID was very valuable in everything from helping with education, outreach, and to arranging meeting rooms for trainings and orientations, to going to tribal council for approvals on what homes to select.” The value of partnerships with the Office of Indian Energy, Sandia National Laboratories, and the National Renewable Energy Laboratory, and the utilization of resources they have for tribes to access, were also highlighted multiple times throughout the projects.

Building Relationships: Building and strengthening relationships over time to create a network of support and resources was often discussed. For several projects, partnerships came about through long-standing relationships that existed prior to project inception. “It was a long road. We started talking with our partners at GRID Alternatives at a program review a few, three years ago I think.” One tribe mentioned how the success of one of their previous projects and the “proven track record” of their technical partner prompted them to team up with the same contractor once again for their newest project, demonstrating the importance of building trust. Some discussed the value of maintaining partnerships after project completion and how this can help build momentum for future project development. Others described how the project itself enhanced relationships: “The net-metered project has fostered a new relationship with [the utility] and they have been supportive of other future endeavors... It is likely that the next phases of community energy generation, storage, and delivery in and around [the reservation] will build on that relationship and continue to solidify the Tribe’s energy sovereignty in reaching its net zero goal.”

Intertribal Collaboration: Intertribal knowledge-sharing and collaboration was also discussed as an element of success. In preparation for developing their own solar installation, representatives from one tribe visited another tribe’s completed solar project. One alluded to collaboration with neighboring tribes on projects: “We’re close to several reservations and we all talk and collaborate and work together on all sorts of projects”. Another tribe recommended engagement with intertribal organizations such as the Midwest Tribal Energy Resources Association (MTERA). Several reports and presentations commented on the sense of pride felt after completion and excitement to serve as leaders paving the way for other solar projects: “We want other tribes to see what we’ve been able to accomplish and hopefully, you know, create something similar that meets your tribal community needs.”

Communication: Another prevalent topic across many of the projects was the need for clear and ongoing communication with all involved with and affected by the project, including tribal leadership, utility providers, contractors and volunteers, and other tribal and non-tribal agencies and departments. One emphasized, “More and better communication with all stakeholders is key.” Some projects experienced delays or complications due to a lack of communication: “Dissemination of information between the Tribe and contracted parties could have been vastly improved upon.” Others stressed the importance of coordination concerning the project timeline and individual schedules: “We did have some targeted times that were missed due to circumstances un-foreseen and coordination... There are many outside factors and potential pitfalls to a project of this

complexity, so when things don't work due to harsh weather for example, the coordination becomes even more critical.”

In other cases, keeping everyone involved and up to date on schedules, progress, and relevant project details kept the project running smoothly: “One of the big areas where I think that we were able to achieve where I think some areas struggle is: this is a real coordinated effort that we were able to bring together.” The use of regular weekly or monthly meetings and progress reports was common among the projects. In a few cases, an advisory group or working group was created to collaborate with contractors and partners. Overall, regular, “open and direct lines of communication through the duration of the project” were recommended.

Several tribes talked about the importance of setting explicit expectations and responsibilities for contractors, volunteers and others involved in the project. Others commented on the need to work closely with outside agencies to obtain required approvals and permits, such as the Environmental Protection Agency (EPA) or regional Bureau of Indian Affairs (BIA) office, and that this can sometimes be time-consuming or challenging. Many also mentioned working closely with the Office of Indian Energy throughout the grant period, not only to keep the granting agency informed on project progress, but also to work together to overcome any challenges that might arise: “[the Tribe’s] relationship with the project managers at DOE Energy Efficiency and Renewable Energy (EERE) also contributed to how smoothly things progressed. Regular reminders for reporting deadlines, easy access by email and telephone, and willingness to help with any issues or problems made working with DOE a pleasure.” Since the 2005 Energy Policy Act, The Office of Indian Energy was created, taking the place of the former EERE Tribal Energy Office; IE is now its own division equal to EERE.

The support of tribal leadership throughout the project and of keeping leaders informed on project progress was emphasized: “Support of Executive Council and the tribal community is essential to success.” One project report recommended finding a champion within tribal leadership to take the initiative to pursue renewable projects and gain momentum. Well-informed tribal leaders can help to facilitate communications with other parties, such as utility providers and utility commissions. A couple projects touched on the topic of tribal leadership and tribal staff turnover, and the importance of keeping new staff members informed, especially for projects that take place over the span of multiple years. “Always, always, always include the Tribal Council.”

Effective communication with utility providers was also discussed. Several projects mentioned the great deal of time and effort that goes into negotiations with electric utilities when entering into interconnection agreements or power purchase agreements. It was highly recommended to account for this in the project timeline and to engage with utilities as early as possible. It was also mentioned several times that utility policies and incentives are constantly changing and evolving, which may have consequences that affect the project or future projects. It was recommended to foster a relationship between tribes and utilities and try to stay as informed as possible. One noted: “The biggest lesson to come out of this is to communicate with your local utility authority/provider. Each utility provider has their own rules and regulations regarding renewable energy installations.”

6.3. Building Capacity

Internal Expertise: Throughout many of the tribal energy projects, a shared overarching theme was the importance of developing expertise within the tribe and how this contributes to improved long-term success. One project report commented on how “building capacity and understanding was an important ingredient in the whole project both on the job and within the administration.” Another

highlighted “the importance of delegating appropriate individuals to champion energy work”, noting, however, that each individual working on their project had to balance other job requirements outside of the solar installation. In order to “centralize project development and administration”, establishing a working group, team, or a hired position charged with management of the Tribe’s energy development efforts was recommended multiple times: “By establishing a Renewable Energy Team, it allows for the Tribe to continue to move forward with projects already awarded and in progress versus starting from scratch.”

Many of the tribes incorporated solar installation training as a major component of their projects. One noted that “Continued training programs may be beneficial to allow the Tribe to function as a sovereign entity”, rather than relying on partners and outside contractors. There was also discussion on how having local community members trained in solar installation aided in their project: “Internal assets of the tribe were used to do the physical installation of the systems, and that really helped to keep costs down”. By building internal solar installation expertise, tribes can better position themselves for future solar deployment efforts, reducing the need for contracting solar installation labor outside the tribe while simultaneously creating local job opportunities. One tribe proclaimed, “There are now community members here who can install panels through the training they received and can now do our own installations”.

Several tribes also incorporated post-construction operations and maintenance (O&M) training for tribal building and maintenance staff and discussed the importance of maintenance to the longevity of the project. One commented on how “having staff knowledgeable about the system and capable of addressing minor to moderate issues has already proven of benefit on several occasions.” In addition to receiving maintenance training, one report mentioned that tribal staff would benefit from being more actively involved in the project throughout the planning and construction process. “Some of the project team received high-level training on the operation and maintenance of the facility. This training was not sufficient to take over the direct operation and maintenance activities, but it did familiarize the team with the equipment and helped facilitate improved long-term ownership and management of the facility.”

Workforce Development: Many of the tribes that incorporated solar installation job training for tribal members described it as a positive experience that provided trainees with valuable solar installation work experience that will aid them in finding jobs in a fast-growing industry. One said, “It’s great to have classes and opportunities, but when you couple that with a job opportunity and real world experience, that is a great way to start building capacity.” There was an overall positive response from trainees and community members for the projects that incorporated a workforce development component. One of the project reports discussed the positive impact that the training had on both the trainees and the residents receiving rooftop solar installations, describing it as an empowering experience that enabled community members to help each other. “The fact that trainings were done on tribal homes especially resonated with the community...It was a cousin-helping brother, son-helping mother and everyone focused on learning solar which was very positive and empowering. The participants were not getting a hand out, there were getting a hand up and helping someone else at the same time, especially family.” In many cases, trainees showed great interest in future training opportunities and solar installation jobs.

Building on Success: The process itself of developing a solar installation project was often attributed as a contributor to building internal capacity. Many project reports and presentations discussed how the experience gained from one project helped them to better understand how to plan and execute future projects. One noted: “This project allowed a strong team to develop by building skills and obtaining the specialized tools needed for solar deployment.” Another said, “This

project provided the impetus for new skills sets and dramatic expansion of local capacity.” In several cases, the success of the grant project has directly led to the tribe pursuing additional projects. One of the tribes said, “Because of the success of this program, the Tribe has also worked to assist Tribal members in obtaining solar for their individual homes and successfully installed solar panels to 49 low-income Tribal members’ houses”. Many talked about how previous projects helped to lay a foundation and pave the way for subsequent projects, and several discussed how they started out with “low-hanging fruit”, small-scale projects and built on the success of those projects until they were ready to pursue larger-scale projects.

6.4. Exercising & Advancing Tribal Sovereignty

Tribal Policy and Energy Enterprises: In several instances, tribal policy was utilized to support tribal energy and sustainability goals. In one example, “to address its vehicle-related emissions (as well as to lower energy consumption at Tribal government facilities), [the Tribe] has established a four day work week for the majority of Tribal government employees”. In response to challenges related to roof-mounted solar involving voided warranties and loading issues, the same tribe is considering a policy “to ensure that new construction considers renewable energy options as part of the design process”. Another tribe established a policy to aid in the selection of homes for residential solar installations in alignment with the community’s definition of permanence.

Several tribes also mentioned tribal enterprises and non-profits established to support economic and energy development, some of which served as grantees or project partners. One noted that “Using internal assets of [their economic development entity] allowed tremendous flexibility in deployment, local (native) labor and met a stated objective of the grant to build local capacity.”

Tribal Utility Formation: Several of the tribes mentioned having an existing tribal utility authority prior to project inception, all of which were mentioned as playing major roles as partners in project development. Several other tribes mentioned aspirations to form a tribal utility authority. One described their plans for a future microgrid project: “When the Tribe eventually forms a Tribal Utility Authority, they will be generating their own power on the reservation and importing additional power as needed that they buy on the wholesale market. This front-of-the-meter microgrid project would then be located inside the TUA but would still be offsetting wholesale rate electricity that the Tribe would otherwise purchase on the market.” Another also discussed their future and the role that tribal utility formation plays in energy independence: “Community, residential, and utility scale projects will definitely be in the future, along with tribal utility formation. And as this goes on, the microgrid and energy storage are pretty much inseparable from this. And all this leads to energy independence.”

Expanding Sovereignty Through Energy Development: Previously, the tribal energy discussion was framed as utilizing sovereignty as a tool for energy development, but the conversation has changed considerably as people realized developing tribal energy is a tool to advance sovereignty. Within strategic plans, energy visions, and stated project goals, there were numerous aspirations of sovereignty, self-sufficiency, and independence. Almost every tribe described their project as a step toward achieving these aspirations, with one remarking that “The Tribe’s vision of a net-zero electrical independence for its communities became a clearer reality with this project”. Another said, “The solar PV project represents important steps in both acknowledging the Tribe’s environmental ethic and achieving the Tribe’s long-term goals of energy independence and the utilization of clean, renewable energy sources.”

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7. RECOMMENDATIONS

There is a clear emphasis on community throughout both the literature and the projects. Both highlight not only the direct benefits of tribal solar development, such as reduced energy expenses or improved resilience, but also indirect benefits like economic development and capacity building. As such, I conclude that using a holistic, community-based approach to energy development is a promising pathway to success. Many of the projects already demonstrate elements of this: strategic energy planning; utilizing a phased approach of project development; partnering and collaborating with tribal departments and businesses; involving community members of all ages through education; workforce development, and overall utilizing solar energy as a tool to better the lives of tribal members through installations on homes, schools, health and wellness centers, and critical facilities.

Holding strategic energy planning sessions or workshops can help tribes to articulate achievable goals with actionable steps and lay out long-term energy visions as a community. Revisiting and revising these energy plans and goals over time as the tribe's energy environment evolves is also recommended. Strategic planning, along with other **early and ongoing community engagement efforts**, ensures that energy development is in alignment with the tribe's overarching goals, values, and needs. Educating community members on project impacts and benefits, as well as keeping them engaged with tribal energy development efforts even after project completion can help to keep momentum going from project to project.

Utilizing a phased approach of project development by starting small and building experience and expertise over time is an additional recommendation based on the strategies employed by tribes in the analysis, as smaller-scale projects are less capital-intensive and more easily deployable. There was a consistent theme that suggested starting small can reinforce momentum and build the capacity needed to plan and execute larger projects. There was considerable discussion on how one project or project phase helped to build skills and experience to pave the way for subsequent projects.

Forming a network of collaborations and partnerships with tribal departments, businesses, and other tribal entities is one recommendation to contribute to building internal expertise and promoting the long-term success of tribal energy development. Many of the projects in this analysis have been developed through collaboration with tribal housing authorities, tribal employment offices, environmental departments, tribal utility authorities, and other community-based entities. Intertribal knowledge-sharing and partnerships may also serve as promising avenues for successful tribal solar deployment; despite the wide range of varying geographies, cultures, history, sizes, and technical capacities among tribes, there is much that can be learned from each other concerning the complex realm of energy development. Networking events, such as the Office of Indian Energy program review and online resources such as IE's monthly webinars, are successful avenues of communicating project successes and lessons learned to other tribes, and **it is recommended that these and other collaborative knowledge-sharing sessions should be prioritized within organizing bodies.**

In regard to partnerships with non-tribal entities such as nonprofits, utilities, and contractors, it is clear from the analysis that these types of partnerships have contributed to the success of tribal solar projects. However, there has also been significant discussion on topics such as difficulty engaging with utilities, keeping up with policy changes relevant to tribal solar development, or the challenges associated with negotiating interconnection agreements. For this reason, good communication between all stakeholders is key in navigating barriers. We recommend the utilities and other non-

tribal entities try to **foster open lines of communication and build working relationships with tribes**. One avenue of doing so may be to establish a tribal liaison role. The importance of close coordination and clear communication with tribal and non-tribal partners alike has been stressed throughout the projects. The need for **establishing trust over time** has also been a point of discussion, especially relating to external actors working within the community conducting outreach activities.

Working to build internal capacity and eventually creating a dedicated team, working group, or department charged with managing energy planning and projects can help to centralize energy development, address issues of staff turnover, and maintain momentum from one project to the next. Often, those working to obtain funding for and develop tribal solar projects have other job responsibilities, so establishing a group dedicated to energy can help to place more priority on these efforts and foster the long-term success of the community's energy development as a whole. **Incorporating workforce development opportunities into projects** has also been a successful strategy for many of the tribes to tackle issues such as poverty and unemployment, as it enables capacity-building, job creation, and economic opportunity.

It is important to note once again that no two tribes are the same; what has worked well for one tribe may differ significantly from what has worked well for another. There is not a "one-size-fits-all" approach to tribal energy development, and tribes have varying levels of experience, goals and values, and approaches to energy development. However, through collective experiences working to deploy tribal solar installations, there are also many commonalities and shared lessons learned, strategies, and recommendations that may be utilized across Indian Country to foster the success of tribal solar projects.

8. LIMITATIONS & FUTURE WORK

The scope of this analysis is limited to DOE-funded solar photovoltaic projects executed within the contiguous United States. We recognize that this analysis is not comprehensive, did not include projects funded through other means, projects deploying other types of renewable technologies, and projects in Alaska; but recommend follow-up studies to build on this work. Including non-DOE funded projects would broaden the measurable examples of successful solar projects. Further effort should also be devoted to expanding this analysis framework to other technologies such as wind. Additionally, an Alaska-specific analysis would be a valuable pursuit, as there are many barriers, challenges, and opportunities that are specific to Alaska Native communities.

The analysis is also limited by the fact that it relies on final reports of completed projects and presentations from recent in-progress projects, each of which have already experienced some level of success: they have been awarded a grant and have made varying amounts of progress toward project completion. Projects that were not awarded grants or were not completed for various reasons are not visible in the data, which means some valuable lessons and recommendations from other projects are unaccounted for in this analysis.

Another limitation to consider is that analysis was based only on what was written within project reports or discussed within the time allocated to each project presentation. Reports and presentations varied in brevity and content: some went into copious detail on project lessons learned and recommendations, while others were more concise or focused heavily on technical details. For every project, there are likely many relevant details that did not make it into reports or presentations and were thus not included in the analysis. Additionally, the long-term impacts of projects on the tribe and community are not captured in the data, as discussion within reports and presentations typically takes place prior to or within the year of project completion.

Due to time constraints, interviews for this analysis were not approved. Ensuring that research complies with Institutional Review Board (IRB) expectations, as well as individual tribal research ethical standards and data ownership policies, is time-consuming but essential. To address the limitations discussed above, future work should be devoted to conducting interviews or focus group discussions with project representatives. Inter-tribal gatherings or conferences, such as the annual Office of Indian Energy program review, present ideal opportunities to do so. Individual discussions would be beneficial to gaining a richer and more detailed understanding of the challenges and successes of projects.

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APPENDIX A. OVERVIEW OF PROJECTS

Table A1. Project Reports Include in Analysis

Project	State
Tonto Apache Tribe - 2014 Project	Arizona
Tonto Apache Tribe – 2015 Project	Arizona
Fort Mojave Indian Tribe – 2019 Project	Arizona
Agua Caliente Band of Cahuilla Indians-2015 Project	California
Bishop Paiute Tribe – 2015 Project	California
Pala Band of Mission Indians – 2015 Project	California
Soboba Band of Luiseño Indians – 2015 Project	California
Washoe Tribe of Nevada and California – 2015 Project	California
Bishop Paiute Tribe – 2016 Project	California
Soboba Band of Luiseño Indians – 2016 Project	California
Bishop Paiute Tribe – 2018 Project	California
Tolowa Dee-ni' Nation – 2018 Project	California
Colusa Indian Community Council Solar Canopy Expansion – 2019 Project	California
Southern Ute Indian Tribe - 2014 Project	Colorado
Ute Mountain Ute Tribe – 2017 Project	Colorado
White Earth Reservation Tribal Council – 2016 Project	Minnesota
Chippewa Cree Tribe – 2016 Project	Montana
Little Big Horn College – 2016 Project	Montana
Winnebago Tribe - 2014 Project	Nebraska
Ho-Chunk Incorporated – 2017 Project	Nebraska
Ho-Chunk, Inc. – 2018 Project	Nebraska
Santo Domingo Tribe – 2015 Project	New Mexico
Northern Pueblos Housing Authority – 2016 Project	New Mexico
Eastern Band of Cherokee Indians – 2017 Project	North Carolina
Rosebud Sioux Tribe – 2016 Project	South Dakota
Forest County Potawatomi Community - 2014 Project	Wisconsin
Oneida Tribe of Indians of Wisconsin – 2015 Project	Wisconsin
Sokaogon Chippewa Community – 2016 Project	Wisconsin
Forest County Potawatomi Community – 2017 Project	Wisconsin
Bad River Band of Lake Superior Tribe of Chippewa Indians – 2019 Project	Wisconsin

Table A2. Program Review Presentations Included in Analysis

Tribe/Grantee	State	Year	Video Recording Link
Ute Mountain Ute	Colorado	2020	Session 1
Spokane Indian Housing Authority	Washington	2020	Session 1
Akwesasne Housing Authority	New York	2020	Session 1
Flandreau Santee Sioux Tribe	South Dakota	2020	Session 2
Coeur d'Alene Tribe	Idaho	2020	Session 2
Tolowa Dee-ni Nation	California	2020	Session 4
Assiniboine & Sioux Tribes of the Fort Peck Indian Reservation	Montana	2020	Session 4
Bishop Paiute Tribe	California	2020	Session 4
Colusa Indian Community Council	California	2020	Session 5
Graton Economic Development Authority	California	2020	Session 5
Aha Macav Power Service	Arizona	2020	Session 5
San Pasqual Band of Mission Indians	California	2020	Session 7
Ho-Chunk Inc	Nebraska	2020	Session 7
Pechanga Band of Luiseno Mission Indians	California	2020	Session 7
Forest County Potawatomi	Wisconsin	2020	Session 8
Rincon San Luiseno Band of Mission Indians	California	2020	Session 10
Bad River Band of Lake Superior Tribe of Chippewa Indians	Wisconsin	2020	Session 11
Northern Cheyenne Tribe	Montana	2020	Session 11
Colusa Indian Community Council	California	2021	Session 4
Oglala Sioux (Lakota) Housing	South Dakota	2021	Session 4
Bishop Paiute Tribe	California	2021	Session 4
Rincon San Luiseno Band of Mission Indians	California	2021	Session 7
San Pasqual Band of Mission Indians	California	2021	Session 7
Coeur d'Alene Tribe	Idaho	2021	Session 9
Assiniboine & Sioux Tribes of the Fort Peck Indian Reservation	Montana	2021	Session 9

APPENDIX B. CODEBOOK

Table B1. Codebook

Theme: Exercising & Advancing Tribal Sovereignty		
Code	# Excerpts	Example
Challenge: limited by external policies	25	“Conflicting policies issued at the federal, state, & utility commission levels, and the apparent disapproval of this technology by the local utilities also present challenges limiting the wide-spread deployment of solar.”
Energy development advances sovereignty	21	“Further, the installations have resulted in positive steps towards the Tribe’s goals of energy sovereignty and the use of 100% renewable clean energy.”
Tribal utility authority	11	“The Natural Resources Department in coordination with the Tribal Utility Authority continue to monitor the photovoltaic system to ensure that it is working properly with little to no maintenance or other issues.”
Plans for tribal utility authority formation	4	“When the Tribe eventually forms a Tribal Utility Authority, they will be generating their own power on the reservation and importing additional power as needed that they buy on the wholesale market.”
Tribal energy enterprises	3	“Sovereign Power, this is a – this power company is owned by the Spokane Tribe and they helped with the project also”
Tribal policy	3	“Finally, to address its vehicle-related emissions (as well as to lower energy consumption at Tribal government facilities) FCPC has established a four day work week for the majority of Tribal government employees.”
Theme: Building Capacity		
Code	# Excerpts	Example
Dedicated energy team/position	15	“By establishing a Renewable Energy Team, it allows for the Tribe to continue to move forward with projects already awarded and in progress versus starting from scratch”
Workforce development training	18	“As a component of the goal to look towards the future for this project’s outcome and future projects, a work-force development component was built into the project
Benefits of training local tribal staff	16	“Another lesson is to enable staff through capacity building and trainings to better understand a photovoltaic system of this magnitude”
Operations & maintenance	11	“WEPD observed the need for increased Tribal knowledge of maintenance and operations of solar arrays by Tribal building and maintenance staff. Staff held an operation and maintenance training day in October for building maintenance staff, in conjunction with BRS, but continued training programs may be beneficial to allow the Tribe to function as a sovereign entity”
Positive experiences with workforce training	8	“The job training aspects of the program were positive with tribal trainees learning a great deal, by their work on multiple projects, over a period of months. Many of the trainees wanted more training and opportunities to learn solar

		installation with the hopes of getting a job in the solar industry"
Building capacity through project development process	19	"This project provided the impetus for new skill sets and dramatic expansion o local capacity"
Starting small/low-hanging fruit	7	"Look for some low-hanging fruit types of projects that it can do to improve its energy infrastructure and set long-term planning goals."
First projects lay foundation for more	35	"This project has created a foundation for renewable energy development of which the Tribe can grow upon."
Theme: Comprehensive & Inclusive Planning		
Code	# Excerpts	Example
Continuous search for funding	8	"Generally, it can be said that seeking funding opportunities are a critical element and essential element in process success."
Early & ongoing outreach and education	32	" Dissemination of information between the Tribe and contracted parties could have been vastly improved upon. Community involvement and support could have been heightened through the scheduling of informational meetings that explained the overall project scope, benefits, associated costs and anticipated deliverables upon completion."
Flexibility	13	"In this project, flexibility was key to implementation and the resultant outcomes"
Comprehensive planning	18	"If a tribe is considering alternative energy projects, it would seem that the best direction is a complete planning process that allows for consideration of a wide range of potentials."
Community support	11	"Finally, support of Executive Council and the tribal community is essential to success."
Maximizing benefits	12	"Before pursuing additional generation, we recommend that the Tribe conduct energy efficiency audits, implement load scheduling, and implement additional energy efficiency measures across their portfolio of buildings."
Planning for future life of project	5	"As a component of the goal to look towards the future for this project's outcome and future projects, a work-force development component was built into the project."
Communication of benefits & success garners support	10	"Response from the community has been positive overall with realized monthly savings and pride to be a part of a program to helping the environment. The demand for the Program is growing throughout the community and is spurning tribal leaders to seek additional funding to make solar possible for the community"
Strategic energy plans or visions	18	"Developing this project, we used both strategic energy planning done in 2012 and 2017."
Supplemented with energy efficiency measures	22	"So, yeah, the weatherization is super important because if we can focus on that, that would reduce the size of the systems that we need to build and pay for. Up to a 30 percent reduction in the size of our system is a pretty good savings."
Thorough research & analysis	28	"Site selection and evaluation during the planning stages could have been more thorough. Analyzing each sites

		possible production and historical consumption on a site by site basis would have proven to be beneficial before installation.”
Turnover	2	“As progress began on the project, the Natural Resource Department (NRD) was able to successfully re-connect with Affordable Solar to identify and understand where the project left off, inquire and review tasks, completed and uncompleted, invoices and worked collaboratively to get the project back on track and to move forward.”
Value of local knowledge & input	7	“ The group provided local input and knowledge which was very valuable in that they provided information which kept the project from problems which may not have been apparent in maps or building records.
Theme: Fostering Partnerships & Collaboration		
Code	# Excerpts	Example
Advisory group	3	“The Tribe coordinated with contractor using an advisory group that met with contractor regarding project progress, problems, dates, etc.”
Building & strengthening relationships	9	“The need for strong relationships with the contractor, and knowledge of how the other agencies schedule work is important”
Communication with staff & contractors	33	“Dissemination of information between the Tribe and contracted parties could have been vastly improved upon.”
Communication with external agencies	18	“Working closely with the Tribal Lands Division and the regional BIA office to obtain all required project permitting.”
Communication with tribal leadership	17	“Always, always, always include the Tribal Council.”
Communication with utility providers	13	“The biggest lesson to come out of this is to communicate with your local utility authority/provider. Each utility provider has their own rules and regulations regarding renewable energy installations. We were unaware of the large interconnection fees with this project and put us off budget”
Coordination among all involved	4	“Communication and clear understanding of schedules: We did have had some targeted times that were missed due to circumstances un-foreseen and coordination plans for each particular event required agreement between the contractor, our staff, and other agencies. There are many outside factors and potential pitfalls to a project of this complexity so, when things don’t work due to harsh weather for example, the coordination becomes even more critical.”
Knowledge-sharing and collaboration among tribes	6	“One of the things that I feel really proud about for the tribe is that it is paving the way for others’ solar projects, because this is the first time any consumer has approached the City of Flandreau seeking to interconnect for a project like this. And so we’re opening the door for others on this level, so that’s something that’s been wonderful”
Maintaining relationships after project completion	4	“Maintaining partnership with GRID Alternatives while keeping community apprised of future opportunities are additional areas that are recommended to continue development and support depending on time and funding. “

Negotiations can be lengthy or challenging	4	“Anticipate delays in successfully entering into an interconnection agreement with local power company.”
Partnerships with contractors	8	“Staff are also very happy and supportive and have had great communications with the contractors towards staff training and future maintenance.”
Partnerships with nonprofits	15	“It was a long road. We started talking with our partners at Grid Alternatives at a program review a few, three years ago I think”
Partnerships with utilities	4	“Strengthening the relationship with the local electric cooperative and their primary power provider”
Routine meetings & open lines of communication	6	“Routine weekly or (at a minimum) monthly meetings with the Project Manager and EPC kept the Tribe well informed and able to keep DOE well informed.”
The value of partnerships	29	“Really these are complex projects that require a lot of a lot of partnerships and uh teaming up to in collaboration to ensure their success”

Table B2. Number of Code Occurrences by Theme and Project

Project ID	Building Capacity	Comprehensive & Inclusive Planning	Exercising & Advancing Tribal Sovereignty	Fostering Partnerships and Collaboration
01	1	3	0	8
02	0	5	2	7
03	0	3	0	1
04	6	8	2	3
05	0	3	2	2
06	1	2	1	2
07	5	0	1	4
08	0	1	1	0
09	1	0	1	1
10	1	3	1	2
10	1	4	0	3
10	3	3	0	2

11	3	1	0	0
11	1	0	0	2
12	0	0	5	0
12	2	0	0	0
12	0	0	0	2
13	3	1	0	4
14	5	1	4	12
14	2	1	1	1
15	1	1	0	1
16	2	4	0	7
17	2	1	0	3
18	1	0	0	1
19	5	0	2	1
20	2	3	1	3
20	2	0	3	0
21	4	3	5	4
22	1	3	0	1
23	8	1	1	2
24	2	1	0	1
25	6	9	5	9
26	1	8	3	6
27	1	5	0	1
28	2	4	6	1

28	3	5	3	1
29	0	7	3	1
29	1	7	1	4
30	1	3	3	0
30	1	0	2	2
31	2	0	1	3
32	1	5	1	1
33	9	6	3	3
34	1	9	0	3
34	1	1	0	2
35	0	7	1	1
35	1	2	0	1
36	0	2	0	3
37	1	4	0	5
37	3	6	0	3
38	0	7	1	1
39	3	3	0	0
39	2	3	1	4
40	6	4	3	2
41	2	2	1	1
Totals	113	165	71	138

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