

SOLAR PROGRAM REPORT

A Restorative Economy Program Case Study



Artwork by Lyncia Begay, Just Transition Fellow, BMWC 2016

Black Mesa Water Coalition
AUGUST, 2016

TABLE OF CONTENTS

Executive Summary

Purpose and Background

Summary of Findings: Recommendations for Solar on the Navajo Nation

Future for the Solar Program

Introduction: Black Mesa Water Coalition and the Restorative Economy

Introduction to Black Mesa Water Coalition

Black Mesa: Source of Southwest Power

Climate Change on the Navajo Nation

What is Just Transition?

Restorative Economy Program

Black Mesa Water Coalition's Solar Program

History of the Solar Program

Solar Landscape of the Navajo Nation

Forest Lake Chapter House Solar Panel Case Study

Opportunities and Recommendations for Solar on the Navajo Nation

Net-Metering

Just Finance and Investment

Operations and Maintenance Program

Education, Operations and Maintenance

Green Jobs and Green Business Incubator

The Future of the Solar Program

A New Chapter

Continued Education

Further Research

Conclusion

Endnotes

ABOUT THIS REPORT

This report was compiled in fall 2016 from sources including Black Mesa Water Coalition (BMWC) archives and reports available on our website, from website text written by BMWC staff and partners, from interviews with BMWC staff and interns, and from contextual research from academic, public online sources and renewable energy experts. The report was compiled by Stina Janssen, a student at University of Arizona with funding from the Climate Assessment for the Southwest and the Renewable Energy Network, and published by BMWC. More information about BMWC can be viewed on our website at www.blackmesawatercoalition.org.

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Celebration of newly-installed solar panels at Forest Lake Chapter House
August 2016 (photo by Shadia Fayne Wood of Survival Media Agency)

EXECUTIVE SUMMARY

PURPOSE OF THIS REPORT

Black Mesa Water Coalition (BMWC) is a 501(c)3 nonprofit founded by Navajo and Hopi youth in 2011. “BMWC is dedicated to preserving and protecting Mother Earth and the integrity of Indigenous Peoples’ cultures, with the vision of building sustainable and healthy communities (BMWC 2016).” Black Mesa, home to the largest coal deposit in the United States and adjacent to 5 coal-fired power plants, has been strip-mined for coal since the 1960s. While distant executives reap the profits, 18,000 Navajo households are off-grid, without access to electricity¹.

BMCW’s Restorative Economy Program develops alternatives to the coal-based economy. We envision the replacement of the coal-based power grid with community-owned and community-controlled solar power and other restorative economic activities.

Over the past ten years, Black Mesa Water Coalition (BMWC) has developed extensive knowledge and context for the development of residential and commercial solar energy on the Navajo Nation. The Black Mesa Solar Program has made strides in education, coalition-building, and research, culminating in the July 2016 installation of rooftop solar panels at Black Mesa’s Forest Lake Chapter House. However, the Solar Program has also encountered numerous challenges and barriers that stand in the way of affordable solar for both off-grid and grid-connected Navajo communities. This report is a compilation of the lessons we have learned from our years of work to make solar energy a viable alternative to coal. This report is intended to guide the future development of our Restorative Economy Program as well as to launch the next phase of the Solar Program.

SUMMARY OF FINDINGS: RECOMMENDATIONS FOR SOLAR ON THE NAVAJO NATION

1. **Net-Metering.** One of the greatest barriers for community as well as residential access to solar systems is the relative lack of cost savings for users. Without a net-metering policy that pays grid-tied producers for the power they generate, solar users are unable to sell excess power back to the grid. Were the Navajo Tribal Utility Authority (NTUA) to develop a net-metering policy, it would facilitate the sourcing of more clean energy for use by Navajo Nation residents.
2. **Investment in Affordable Solar.** Lack of availability and access to capital is one of the greatest barriers for scaling solar to meet the need present on the Navajo Nation. While the Navajo Nation and federal government should invest further in solar for off-grid residential and community use, private investment is also critical. Finance models with a non-extractive finance and reinvestment framework have

the potential to move finance out of the fossil fuel economy and into cooperative loan funds for community-based projects, such as solar for the Navajo Nation.

3. **Operations and Maintenance Program.** While there have been a number of solar projects installed on the Navajo Nation and Hopi reservation, it has been challenging for some solar energy users to access the required ongoing maintenance to keep their arrays, inverters, and batteries operating correctly. Any future solar program, especially those that offer an ownership or lease-to-own option, must include a clear and accessible maintenance program. Ideally, solar maintenance would be done by trained Native and locally-based professionals.
4. **Green Jobs and Green Business Incubator.** While a number of solar projects have been installed on the Navajo Nation and Hopi reservation, many have not been installed by Native solar professionals. While the Solar industry has one of the fastest-growing rates of job creation, not enough of these jobs opportunities are accessible to Native workers. A solar program on the Navajo Nation must include opportunities for training and jobs creation as well as provide opportunities for business management education to enable Native workers to start, own, and manage solar companies.
5. **Continued Solar Education.** As more solar arrays are installed, familiarity with solar energy grows. Solar installations on community buildings are especially beneficial as their wide use ensures exposure to the utility and cost-savings a solar array offers. Education to both introduce solar to new users as well as to inform users about proper use and maintenance is vital for a successful and sustainable program.
6. **Further Research.** Further research conducted by Navajo community members will support the development of an affordable, sustainable solar program by establishing the range of cost burden families are able to pay per month for a lease-to-own solar system and the necessary maintenance. Additionally, the 18,000 households must be located and mapped if they are to be adequately reached and included in the program.

FUTURE OF THE SOLAR PROGRAM

This report is published to document a decade of solar development research, community organizing, and education done through Black Mesa Water Coalition's Solar Program, as the Program turns the page to a new chapter. Longtime Solar Program Coordinator, Wahleah Johns, will leave BMWC to continue her work on solar through a new enterprise called Native Renewables. BMWC will continue its education and

organizing work on solar. Native Renewables intends to expand and deepen partnerships with investors and allies to support the development of affordable solar options for Navajo and Hopi communities.



Community members celebrate new solar capacity at Forest Lake Chapter House, August 2016 (photo by Shadia Fayne Wood of Survival Media Agency)

INTRODUCTION: BLACK MESA WATER COALITION AND THE RESTORATIVE ECONOMY

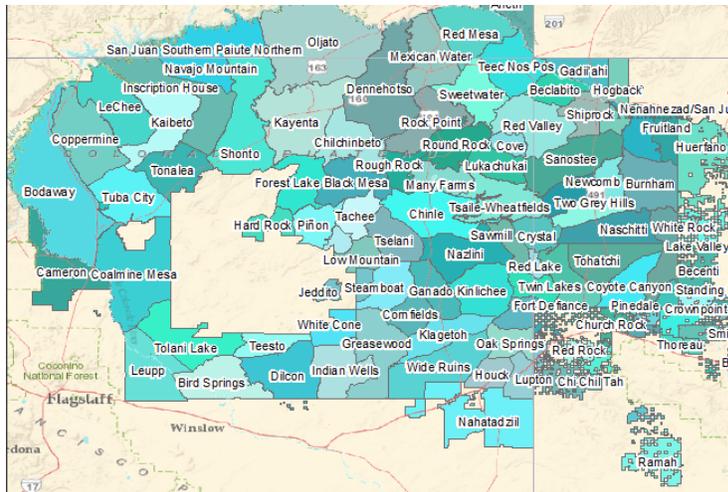
Under a vast network of transmission lines stretching way from the Navajo Nation to sprawling Southwest cities are 18,000 Navajo households lacking electricity (Begay-Campbell 2005). While the Navajo Nation government gains revenue from coal, the Nation is also faced with the growing threats of climate change exacerbated by the carbon emissions from five adjacent coal-fired power plants. Black Mesa Water Coalition imagines and works with communities to create a *just transition* from coal to green jobs and lifeways and that provides affordable renewable energy to communities lacking power.

INTRODUCTION TO BLACK MESA WATER COALITION

“Black Mesa Water Coalition was formed in 2001 by a group of young inter-tribal, inter-ethnic people dedicated to addressing issues of water depletion, natural resource exploitation, and public health within Navajo and Hopi communities (BMWC 2016)” in the Black Mesa region. Today, BMWC is a leader in energy justice issues in the Southwest and nationally. “BMWC is dedicated to preserving and protecting Mother Earth and the integrity of Indigenous Peoples’ cultures, with the vision of building sustainable and healthy communities. We strive to empower young people and spark collaboration with surrounding communities and organizations to address the problems we collectively face (BMWC 2016).”



Black Mesa Water Coalition community
(BMWC Facebook page)



Navajo Nation (photo source: US Census Tiger/line Shapefiles; navajobusiness.com)

BLACK MESA: SOURCE OF SOUTHWEST POWER

“In 1968, Peabody Energy began to extract that liver. The company opened two strip mines, Black Mesa Mine and Kayenta mine. Black Mesa Mine coal was mixed with water from the Navajo Aquifer—3 million gallons per day and the sole source of drinking water in the regionⁱⁱ—and sent through a slurry pipeline 273 miles to the Mohave Generating Station (MGS) in Laughlin, NV. MGS provided cheap electricity for the major southwestern cities including Las Vegas, Los Angeles, and Phoenix for nearly 40 years before BMWC and other community groups shut it down in 2006. The Kayenta Mine provides coal to the Navajo Generating Station (NGS) located in Page, Arizona. At 2,250 megawatts, NGS is the largest coal-fired power plant in the western U.S. and the third largest emitter of carbon dioxide. NGS pumps water from northern Arizona to central and southern Arizona through the Central Arizona Project (CAP). NGS is also the only coal-fired power plant in the country majority-owned by the federal government through the U.S. Bureau of Reclamation (BMWC 2016).”

“This infrastructure transported essential resources to central and southern deserts of Arizona, essentially building the state. The coalmines on Black Mesa are part of a legacy started in the early 1920s to ensure the Navajo Nation’s economic dependence on fossil fuel development. The Navajo Nation’s first Tribal Council, created in the early 1920s, was a business council formed explicitly to sign oil deals with large energy corporations. The colonization of the west and construction of its booming desert cities took incredible feats of engineering and extraction and the Navajo Nation has been the sacrifice zone for its growth and consumption. Today, our Nation is an illustration of a broken economy dependent on fossil fuels. Despite promises that uranium, oil, gas, and coal leases would bring in millions of dollars in royalties and create thousands of jobs, and a public narrative that claims mutual benefit, a visit to our reservation reveals a completely different reality.



The Navajo Generating Station. Photo credit: azcapitoltimes.com

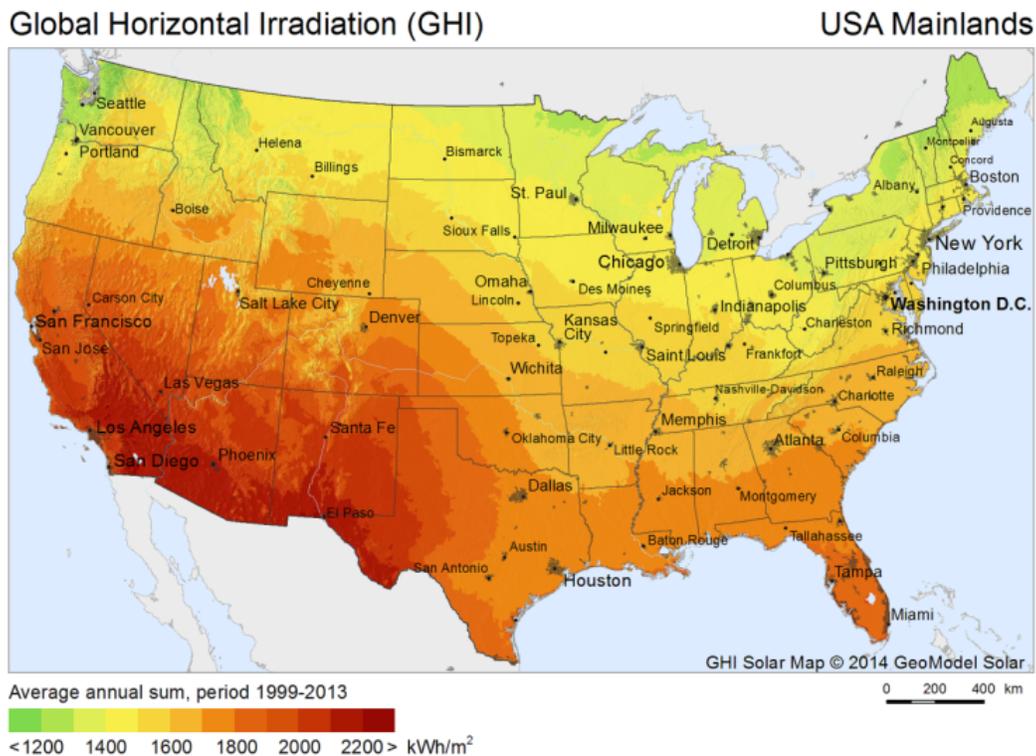
Navajos do not own the mines or plant and receive a slim amount of their profit through royalties and jobs. The Navajos employed through them barely dip into the unemployment rate, which is close to 42%ⁱⁱⁱ. Executives elsewhere rake in revenues, while Navajo people are impoverished and unemployed at many times the national and regional rates, around 56%^{iv} (Division of Economic Development, The Navajo Nation 2010, Moore et al. 2008).

In 2005, BMWC celebrated our success in shutting down the slurry pipeline transporting Black Mesa coal to the MGS and winning stricter emission controls for the MGS, which would later close. Five years later, we organized and won the revocation of Peabody's life of mine permit for the Black Mesa Mine.

While utility lines run right over our heads, 18,000 Navajo households live without electricity equivalent to approximately a third of all Navajo households^v. This accounts for 75% of all un-electrified homes in the United States. With the cost of grid-extension prohibitively high at approximately \$27,000 per mile^{vi} and the average cost per grid connection approximately \$50,000 according to Walter Haase, general manager for the Navajo Tribal Utility Authority^{vii}, there is little hope for any households to receive electricity. Furthermore, the fossil fuel economy has left us with polluted air and land, contaminated and depleted water, resulting in various health ailments and social problems in our communities (BMWC 2016)."

Solar Program Coordinator Wahleah Johns points out the vast disparity in energy access between her Black Mesa community and non-Native US communities. "Energy in general is one of the biggest driver for economic opportunities, from economic

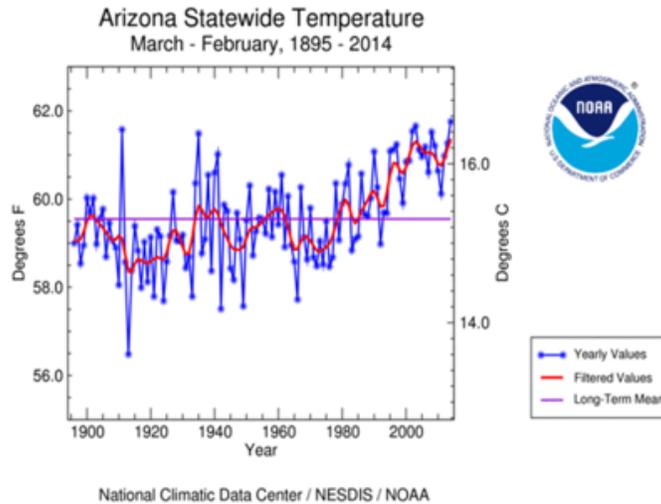
stability to health to livelihoods, and it's a thing most people have access to in this country..." states Johns. "I think about elders who might have health issues [who do not have] refrigeration. Most people have an ice chest and they have to haul ice to refrigerate their food. What if there's not enough light for children to do their homework? I think America doesn't understand—if you're with power all the time you don't think about those things. And as a nation that's been providing cheap power for 50 years...it just doesn't make sense to me."



The Southwest has exceptional sun radiation

CLIMATE CHANGE ON THE NAVAJO NATION

Climate change is another concern that looms on the horizon, promising drastic changes in ecosystems and weather patterns. Compiling climate monitoring on the Navajo Nation with historical accounts from elders, USGS geomorphologist Margaret Hiza Redsteer's research shows that Southwest drought conditions "will hit Navajo people first"^{viii}. Average temperatures across the state of Arizona have risen by approximate 2°C or 3.6°F^{ix}, the threshold deemed a dangerous threshold by the IPCC^x and rising temperatures are projected to intensify. Southwest climate projections suggest an average annual temperature increase as high as 9° F by the end of the 21st century^{xi}. Deepening drought has increased the mobility of sand dunes, posing the risk of buried homes and sand-covered crops and ranchlands^{xii}.



Data from the National Climatic Data Center shows Arizona's average annual temperature climbing steeply. Source: National Climatic Data Center

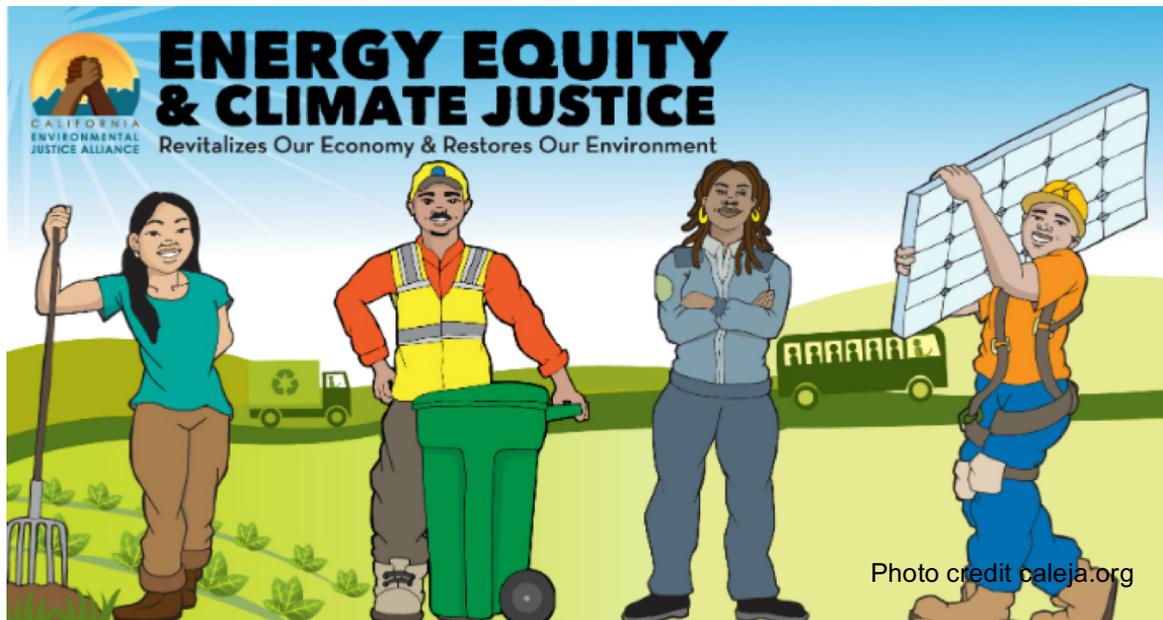
Heat and drought have accelerated the disappearance of ceremonial plants, trees, lakes, and water at well and spring sites^{xiii}. Many communities have experienced aquifer depletion exacerbated by the coal industry's immense water usage^{xiv, xv}. Such hazards are most felt most acutely by rural, low-income households who depend directly on local water sources for their homes, crops and livestock.



A sand dune encroaching on a Navajo Nation home
(photo credit: www.crossingworlds.org)

Our current economic system has forced assimilation to a consumer society which demands that we ignore our traditional teachings to love, respect, and protect Mother Earth. **This has made us economically dependent on our own cultural destruction.** Our dream of a future for Black Mesa and the Navajo Nation beyond extraction, exploitation and climate change is one of a *just transition*.

WHAT IS JUST TRANSITION?



BMWC is a member of the Climate Justice Alliance (CJA), a national coalition of organizations based in communities most directly impacted by the fossil fuel economy: communities of color and poor and working class communities.

A just transition from a fossil fuel economy creates economic alternatives that are regenerative and in which energy is owned and controlled communities. CJA wrote in its 2015 report, “right now...the debate over how to develop a renewable energy future has favored the prioritization of the status quo, which invests in top-down, large-scale approaches, rather than ground-up, community-based responses...[rather]...We need a renewable energy solution that prioritizes community ownership and community governance—not large-scale solutions that will repeat the cycle of exploitative labor and disinvestment (3)^{xvi}.”

We work to build the foundation for just transition through our Restorative Economy Program.

RESTORATIVE ECONOMY PROGRAM

“The Restorative Economy Program represents our long-term vision for just transition. It cultivates an economy that benefits our people, strengthens our culture, and returns the

term “economy” to its original meaning – the management of home. We choose the word “restorative” in recognition of the neglected environmental and social systems we must rebuild to restore the environment, improve human and community wellbeing, strengthen kinship and culture, and put us on the path to a truly regenerative economy. One that exemplifies a balanced way of relating to each other and the natural world, and values the wellbeing of our environment and people first and foremost (BMWC 2016).”



William Anderson of the Moapa Band of Southern Paiutes, Marshall Johnson and Wahleah Johns of BMWC speaking to the community about solar options on KTNN radio, spring 2015 (photo by Stina Janssen)

The Restorative Economy Program has three projects: the Navajo Wool Market Improvement Project, the Food Sovereignty Project, and the Solar Program. **The Navajo Wool Market Improvement Project** creates opportunities for people to learn the traditional processing and uses of wool and aims to build local Navajo capacity to improve the quality of wool production, increase access to the wool market for Navajo producers, and elevate the market value for Navajo wool. **The Food Sovereignty Project** revitalizes the local food systems in the Black Mesa region. With a five-acre community farm, we train youth and community members in traditional and sustainable dry farming techniques and restoration. This program has conducted food assessments and inventories, mapped approximately 130 fields and 947 acres of potential farming lands in the Black Mesa region, and interviewed and surveyed 108 elders and farmers about the fields’ clan history, acreage, use, condition, and family eating habits. We are also working with many Navajo Nation Chapters to create a Genetically Modified Organism (GMO)-free zone. **The Solar Program** is the focus of this report.



Enei Begaye Peter (photo credit visionmakermedia.org)

A green economy is nothing new to Indigenous peoples. We have been practicing this way of life in harmony with Mother Earth before there was a Wall Street. But today, what we strive to do is unite the modern non-polluting technologies, such as wind and solar, with the traditional technologies, such as weaving and farming; and with that unity we can open up new doors of opportunity for ALL our people—young and old, college educated and land educated alike.

—Enei Begaye Peter, BMWC cofounder and board member

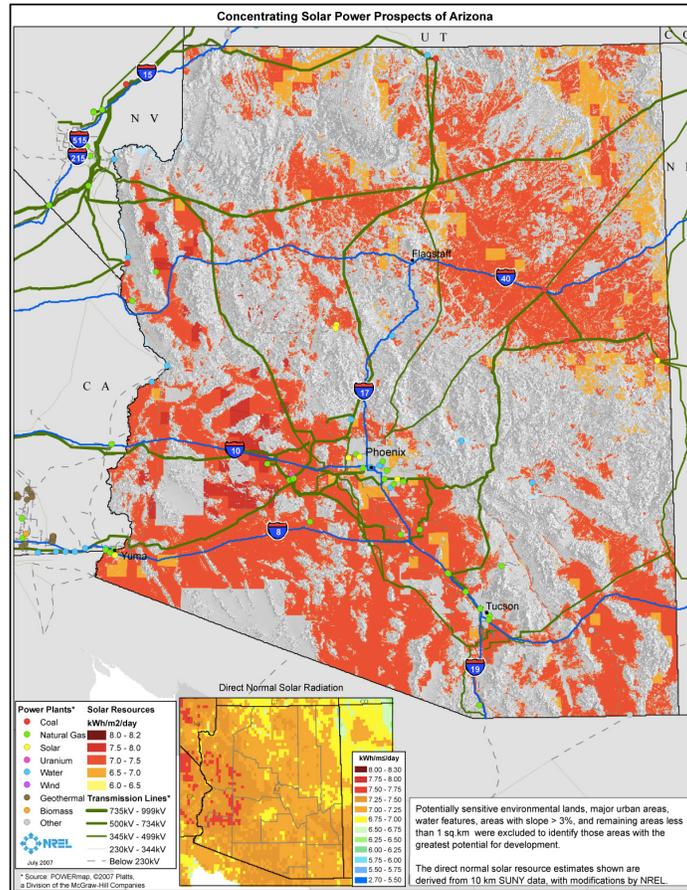
Just Transition Work”).

SOLAR PROGRAM

HISTORY OF THE SOLAR PROGRAM

“With the Mohave Generating Station closing, it pushed me into thinking about *what does transition look like?* If a big mining sector or power plant were to close, if it affected our people and our workers, what’s the alternative?” reflected Wahleah Johns, Solar Program Coordinator for Black Mesa Water Coalition, in July 2016. It was these questions, following our successful campaign to shut down the MGS in 2005, that prompted us to seek out an alternative economic sector and energy source. The excellent solar radiation and wind potential present on the Navajo Nation drew our attention to renewable energy.

The Black Mesa landscape is already developed for energy transmission. Johns recalls that the first step in considering solar options was to research the possibility to repurpose these transmission lines for solar. Beginning with our work as a stakeholder on a 2006 Synapse Energy Economic, Inc. study for Southern California Edison called *Mohave Generating Station Alternatives*^{xvii}, BMWC explored options for utility-scale solar. The report outlined options for selling solar energy to California utilities. California electricity consumers had long benefitted from cheap coal-based energy from the Black Mesa region and this report also explored how the wealthy state of California might pay back compensation to the Native communities whose lives had been affected by the lifecycle of mine and power plant operations (for more, see inset, “Origins of



Solar Potential on the Navajo Nation shown on map of Arizona.
 (source: Platts, a Division of the McGraw-Hill Companies)

Next, Johns partnered with Dominican University to research opportunities to use Brownfield sites or mine reclamation lands for solar projects. Together, they developed a model business plan for a 20 megawatt solar field on reclamation lands. One of the benefits of using former mining lands is that transmission lines, substations, good roads, and infrastructure are in place.

Origins of Just Transition Work

Our communities had subsidized cheap energy with our health for decades. The California utilities planned to profit from the sale of Sulphur Dioxide credits, perhaps \$10-20 million each year. BMWC and other groups formed a coalition called the Just Transition Coalition and went to the California Public Utility Commission, the regulatory agency for Southern California Edison (SCE), the majority owner of the Mojave Generating Station in Laughlin, NV, to petition a set-aside of funds to invest in just transition, the development of renewable energy sources. A mediation process was attempted, which included the Navajo and Hopi governments. BMWC participated in (led?) a campaign to pass resolutions across the Navajo Nation and Hopi Reservation in favor of just transition investment dollars from the Sulphur dioxide credit sales. As Roger Clark, a supporter of this effort, stated in a Daily Miner news story in 2006, "The best scenario would be for Edison to give up trying to keep Mohave open and, instead, invest in alternative energy projects and transmission lines that would help the Hopi and Navajo exploit their potentially abundant wind and solar power resources ... With California wanting to invest in cleaner forms of energy ... why buy another 20 years of inefficient, old coal-fired generation (Bartlett 2006)?" Through this work, BMWC met many other organizations striving for a similar reinvestment in renewable energy to replace coal and oil. **Ending**

Source: Jennifer Bartlett, Jan 17, 2006.

Retrievable at

<http://kdminer.com/news/2006/jan/17/coalition-petitions-for-proceeds-of-credit-sales/>

Additionally, BMWC focused on education and outreach to families and communities in the Black Mesa region, the majority affected by mining. The majority of workers laid off after the Black Mesa mine closure were rehired at the Kayenta mine. We encountered a learning curve for our communities as we traveled across the region presenting about solar. It was important that the community residing near the mining area had a say in the future development of the land. After much dialogue, around 2011, the community decided not to use brownfield lands for solar projects. It was more important for community members to use this land for grazing livestock.

One of this challenges of this process was a lack of clarity about the land status of the Brownfield sites. Without clarity about who owned the land, and who had the power to decide what happened to it, exploring options for solar development was complicated. We learned it's very important to establish clear land status. We also learned to take great care to reach out to and include community members before and during our research process.

Our focus thus became community engagement and commercial solar development for public use. We have focused on community buildings and school. We began by reaching out to and researching with the Pinon Unified School District School in Pinon, AZ. With a heavy emphasis on presentations, we researched how the school system could save costs with solar. It was important to show the long-term savings for the District. We found that with solar arrays on school buildings, the District would save greatly in 10 to 20 years of energy use and that these savings could be

repurposed towards other programs. Through experience, BMWC has learned to use online calculators and other tools to assess cost savings.

We developed a partnership with numerous entities which committed to funding the installation of a public-use commercial solar array. Solar City toured the buildings we had scoped and found that the conditions at the Forest Lake Chapter House approximately 17 miles North of Pinon, was an ideal site for the installation, discussed in this report.

The greatest impact of the solar program has been education, community organizing, and building partnerships. One of the most critical partners for solar on the Navajo Nation will be the Navajo Tribal Utility Authority. In the Bay Area, Wahleah Johns has met with numerous foundations and solar groups and has learned there is much interest in supporting clean energy development but that many potential partners were unfamiliar with the needs of many tribal communities in the US. Education is needed not just for community members but for solar developers, investors, and foundations seeking to support clean energy—of which there are many associated with the movement for 100% clean energy in the Bay Area and elsewhere. For example, Johns worked with Give Power and Solar City to find ways to make solar accessible and affordable to a local Forest Lake Chapter community building.

BMWC has also developed our understanding of the geography for power on the Navajo Nation: the grid-lines, the transmission-lines, the substations, and how these create opportunities for solar development. As we sought to develop solar through various projects, we listened to community attitudes and learned that solar's greatest appeal is in residential and community buildings rather than large-scale solar farms at this time. Through education and building partnerships, our program has laid the groundwork for partnerships and has seeded interest in solar projects across the Navajo Nation and particularly in Black Mesa.

SOLAR LANDSCAPE OF THE NAVAJO NATION

Navajo Tribal Utility Authority

Residential rooftop solar arrays are currently available to off-grid and grid-connected Navajo Nation residents through the Navajo Tribal Utility Authority (NTUA). NTUA is a rural electrical coop established in 1958.

Building New Partnerships

“I’ve been meeting a lot of foundations that are helping rural communities in different countries that don’t have access to power—and saying, hey, we here on the reservation [also don’t have power!]... people who have foundations that want to support clean energy development are not familiar with reservations and tribal communities here in the US. We’re trying to make that connection.”

- Wahleah Johns
Black Mesa Solar Program Coordinator

In the early 1990s, the Navajo Nation received a grant of \$300,000 and other support from the Department of Energy (DOE) through the Western Area Power Administration to launch its Photovoltaic Solar Electric program, the Electrification Demonstration Program Developing a Sustainable Tribal and Rural Cooperative Solar^{xviii}. With this grant, NTUA partnered with Sandia laboratories to design and provide over 75 rural households with 200-watt PV systems. NTUA charged 72 of these homes a monthly fee for maintenance^{xix}. The success of this program inspired the Nation to authorize NTUA to invest \$2 million to grow the program out by 200 additional photovoltaic systems^{xx}.

The maintenance system for this program is such that homeowners enter into a lease purchase agreement through which NTUA performs maintenance and after 15 years, ownership and maintenance of the systems is transferred to the customer^{xxi}.

The new NTUA systems are larger than the original 74 at 600 Watts. Roger Hill of Sandia's Renewable Energy Department, says, "They will be able to convert about 3 kilowatt hours per day on average in the winter... enough electricity to power a single household for a day -- if the family members are conservative in their use of electricity^{xxii}." As of One hundred systems have already been installed, and another 100 are to be delivered to the NTUA throughout the summer. Utility officials are identifying new households to receive units. NTUA has also developed hybrid wind and solar systems available to off-grid households.



Residential Solar Hybrid Unit (photo from NTUA through energy.gov)

In 2004, NTUA had also developed a hybrid solar and wind system that "consists of eight solar panels in an 880-Watt array, a 400-Watt Air-X turbine, and 6-volt batteries in a 24-volt DC configuration," according to the Native American Wind Interst Group^{xxiii}. At the time of publication, NTUA had installed 44 hybrid wind turbine and PV units and had

plans to install 63 more units. These hybrid systems were partially funded by a 2002 \$2.8 million federal grant from Sandia National Laboratories and the DOE to the Navajo Nation made possible through the 2001 Navajo Nation Electrification Demonstration Project, a 5-year program to assist the Navajo Nation in meeting its energy needs. As NTUA reports, “within 5 months, NTUA crews had enabled 505 homes on the Navajo Nation to receive electricity for the first time. In 2003, the Navajo Nation received a \$2.3 million renewal grant (\$1.15 million for electrical line extensions and \$1.15 million for PV and wind systems).” For these systems, NTUA charges families \$75 per month to cover the maintenance cost of the units^{xxiv}.

In 2004, NTUA planned to install 159 more 880-watt PV-hybrid systems to nearly double the number of systems already in use. As of 2012, NTUA reported that 240 systems were in use^{xxv}.

According to NTUA, current pricing for systems run from \$75/month for an 8-module PV and wind turbine system to \$100/month for an 1800 Watt PV and wind hybrid system that includes an energy efficient refrigerator, to a \$149/month for an 8-module PV system plus an LP gas generator[i]. However, other systems and prices are listed at NTUA.com. a 640-Watts Kyocera Solar Power Station with a 1.6 KWH capacity per day is noted to cost a household \$95.00 per month. The solar customer signs a 15-year Lease Purchase Agreement and after that time, if the full contract is paid in full, ownership is transferred to the family. Another example given of a 880-Watt Sunwize Solar Power Station with a 400-Watts Air X Wind Turbine with a 2 KWH per day generation capacity. This system may be installed with no fee and a monthly charge of \$75 which includes the cost of operations and maintenance.

PV and hybrid systems can be used to power: residential lights, radio, communication equipment, computers, television and satellite dishes, a small refrigerator, a small water pumping system, small construction equipment tools, or small kitchen appliances. A backup generator can be used to supplement battery charging (NTUA.com).

These systems and programs are important in meeting the needs of off-grid as well as grid-connected households. However, with these systems available in the hundreds, and the need in the tens of thousands, a more sustainable investment and payment model will be necessary to fill the demand for off-grid, affordable solar.

In addition, nonprofit groups have filled some of the need, including IINA Solutions and Native SUN.



An IINA Solutions residential solar system for an off-grid households (photo credit, IINA Solutions, available at <http://iinasolutions.com/>)

In late 2014, GRID Alternatives installed a 2.6kW grid-tied solar photovoltaic system on the home of a resident of Bird Springs, AZ, a community in Northeastern Arizona, “the first residential grid-tied solar system ever inspected by NTUA,” according to GRID Alternatives^{xxvi}. This report is not a survey of all the many nonprofit and privately-financed solar projects installed on Black Mesa or the Navajo Nation

Utility Scale Solar

In April 2016, the Navajo Nation broke ground on its first utility-scale solar farm, a 27.5 Megawatt facility built on 300 acres in Kayenta, AZ. The Navajo Nation has worked with Salt River Project, the power company that serves Pheonix, to leverage energy credits on this \$64 million project. The project has also benefitted from tax credits and loans, primarily through Cooperative Finance Corporation, an electrical coop finance cooperative. The farm will be in operation by spring 2017 and construction will employ about 100 workers. Once the farm is running, it will employ about five permanent positions. NTUA spokesperson Deenise Becenti stated, “It may not sound like much, but on the average, each employed tribe member helps to support eight others” and that the jobs would enable some workers who had left the area to find jobs to return home^{xxvii}. Salt River Project will purchase the power generated, which it sees as vital for meeting its renewable energy sourcing requirements by 2020. This farm will connect to the grid through the Western Area Power Authority’s Kayenta Substation. The goal is also to provide low cost energy to approximately 7,700 households in the area^{xxviii}



Bill Schwant, General Manager at Moorhead Public Services and reporters at ribbon-cutting for Capture the Sun, 2015. Photo credit, Moorhead Public Services (Photo credit: <http://esnews.wapa.gov/wordpress/category/utilities-news/>)

Additional movement in utility-scale solar development includes a feasibility study for a 4,000-MW solar project at Paragon-Bisti Ranch in New Mexico completed in 2015 by the Navajo Hopi Land Commission with a DOE grant of \$340,000. The study demonstrated that 10,000 acres on five major sites may be suitable for hosting a 2,100-MW capacity PV farm. The project is currently in pre-construction phase^{xxix}.

The landscape of solar on the Navajo Nation has been largely financed by DOE grants and private foundation grants, as in the case of the Forest Lake Chapter House solar system, a gift made to the community in the summer of 2016, following many years of community organizing, discussions, and building partnership relationships.

FOREST LAKE CHAPTER HOUSE SOLAR PANEL CASE STUDY

One of our solar program goals was to develop a solar project to power a Black Mesa community building to save money for the community that could be diverted to youth and community programs, and to raise the visibility and familiarity with solar energy for Black Mesa residents.

Forest Lake Chapter House Solar Array

Approximately 17 miles north of Pinon, AZ sits the Forest Lake Chapter House building, a local governance building where 800 Navajo tribally enrolled members convene for community meetings in rural northern Arizona. During an assessment with Solar City, a large solar company donating labor to a community solar project on Black

Mesa through BMWC’s solar program, Forest Lake Chapter House was found to be an ideal site for the installation.

The building’s energy usage is on average, 15,000 kilowatt-hours per year. In August 2016, the community celebrated the installation of a 7.1 KW photovoltaic array providing solar power to the building with a Tesla Power Wall battery for energy storage – reportedly the first installed in the state of Arizona.

On the journey to developing this project, the Black Mesa Solar Program worked together with partners in the renewable energy installation, finance and development sectors including Empowered by Light, Solar City Phoenix Team, Give Power, Native Renewables and Tonizhoni Ani. Together, these partners considered several prospects. First, we looked at the Pinon Unified School District, which has three large buildings for its elementary, middle and high school. We initially considered building a carport with rooftop solar to provide power for the school and save energy costs. While we worked with the Superintendent, we also considered the Forest Lake Chapter House. Furthermore, the community building was structurally a good fit for the installation and as it is used for many community events, the solar panels would be highly visible in the community and overall support learning about how solar works.



Forest Lake Chapter House (photo by Stina Janssen)

“To begin any project that is grid-tied,” writes Wahleah Johns, “you need to get a sense of yearly usage of energy and consumption to help calculate the size of a solar system. For Forest Lake, [we needed to obtain a] 12-months utility usage [record] from the chapter. The chapter has to request this information from their utility, which is NTUA. Once we received that information, Solar City, Give Power and Empowered By Light help to design a system that will be the right fit.” Johns writes that she “did all the pre-development work of this project, which included two community presentations to



Solar City manager and technician gives BMWC Solar Program Coordinator Wahleah Johns a tour of the work done at the Forest Lake Chapter House during one phase of the installation (photos by Stina Janssen)

acquire approval for the release of utility bills to design a system.” She also “worked with the Navajo Tribal Utility Authority on the interconnection agreement and became a liaison between Solar City, NTUA and the Forest Lake Chapter to stick to the timeline which was to be installed by the end of July. This project was not only feasible because of funds to support the project from foundations, but due to the collaboration it facilitated between many entities.”

This project’s success is marked by the cost savings it provides to the Forest Lake Chapter community, enabling funds to go towards educational and youth programming. The average monthly savings as of February 2017 for this building have been **\$dollars/month.**



Solar City technicians installing the first Tesla Power Wall in Arizona at the Forest Lake Chapter House in July 2016 (photo by Stina Janssen)

Recommendations Acting through this Project

The recommendations offered in the executive summary and throughout this report were at play to varying degrees in this project.

Net-metering: “Navajo doesn’t have a net-metering policy. The excess power – they cannot sell it back,” said Johns during one phase of the installation. Because NTUA does not currently offer a net-metering policy to small, dispersed renewable energy systems, power generated by the PV array will power the building itself but the community will not be paid for the excess power the system sends back to the grid to be used elsewhere. The Tesla Power Wall stores excess power to be used during times when irradiance is low or the energy load is high. The excess energy generated and returned to the grid will not provide any income to the Chapter House, although the reduced energy use will result in a lower monthly energy bill resulting in cost savings for this building. While this arrangement provides cost savings to the community, excess income from selling power to NTUA would make such projects more cost effective. This project is understood, rather, as an efficiency upgrade, as it saves the community money on its monthly energy bill, rather than a energy production project.



Investment: This project was feasible because the investors and philanthropists were not seeking a monetary return on investment. For them, success means that the Forest Chapter residents benefit from the project and that the project serves as an example of the benefits of solar.



Solar City installation in progress, Forest Lake Chapter House, summer 2016
(Photo right: BMWC Facebook, photo by Wahleah Johns; photo left: Stina Janssen)

Operations and Maintenance (O&M): Several of the partners on this project typically work on solar installations in remote places where they are accustomed to following through with O&M as needed. **The O&M agreement is informal but a standard of the industry** and the donated parts are under warranty. While O&M may be appropriate for this project as partners including Native Renewables will remain involved, a consistent O&M program that makes maintenance available and readily accessible to system owners and users will be needed for scaling out off-grid as well as grid-connected affordable solar in the future. Such a program does exist through NTUA's systems, through its O&M agreement with customers.

Local Green Jobs: This project was donated and included donated labor; as such, it did not involve local labor or train new workers.

Education: The array installed at Forest Lake Chapter House has been seen by many community members since its installation in the summer of 2016. The day the solar panels were installed was also the day of a community grazing hearing and a youth program that drew chapter residents and officials from across the region. “Even just the first day of the installation, people would come up to me saying, ‘I want to go solar’. Everyone wants to go solar. There’s just not that opportunity,” said Johns on the second installation day.



Solar installation in progress
(photo by Wahleah Johns)

Tips for Navajo Nation Residents interested in solar

If you are approached by a commercial or residential solar program, here are important questions to ask:

- 1) Will the solar system be rented, owned, or rent-to-own?
- 2) What is the payment structure? What is the cost per month?
- 3) What is the warranty on the system and what does it cover?
- 4) How long is maintenance offered?

Research: This project followed extensive site scoping and included community-based research into the needs and current energy usage of the building. However, this project did not include a research component, apart from this report.

Solar Celebration

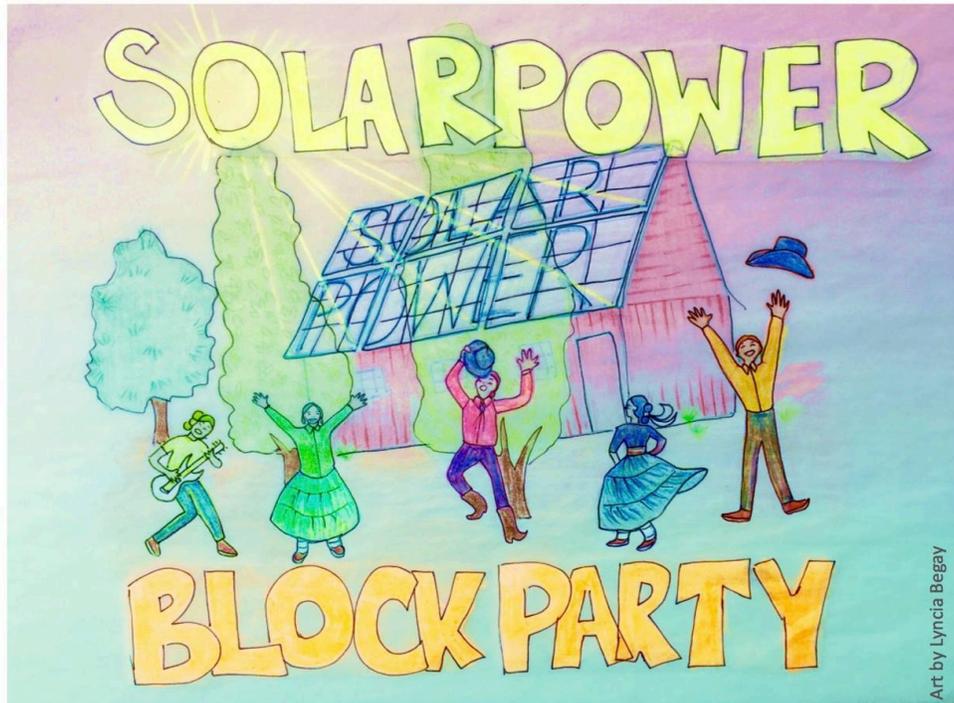
In August, a month following the completion of the solar installation, approximately 50 community members and supporters gathered to hear music, speak, and to learn about the project. Elected representatives, NTUA staff, the project partners, families and community members attended to celebrate the benefits this project would provide to the community.



Community members celebrate new solar panels installed at Forest Lake Chapter House, August 2016 (photo by Shadia Fayne Wood of Survival Media Agency)

The program was primarily given in Navajo. Attendees were excited and expressed feeling that if such a project could be achieved at Forest Lake Chapter, it could be done anywhere. Others asked why such solar projects are not the norm for power across the Navajo Nation and were eager to see more such installations for both community buildings and residential use.

Forest Lake Chapter, Black Mesa Water Coalition, Solar City & Give Power,
Empowered By Light and Native Renewables present:



MONDAY, AUGUST 29TH 11AM-3PM

FOREST LAKE CHAPTER HOUSE

NAVAJO NATION

17 miles North of Pinon, AZ on Route 41
GPS coordinates 36.304945, -110.303686

Food | Music | Exhibitors | Speakers
Tour the new rooftop solar and the 1st Tesla Powerwall
Battery installed in northern Arizona by Solar City
Free event!



See  facebook.com/blackmesawc/ for updates!
Contact: wahleah@gmail.com or (928) 637-5281

SPECIAL GUESTS: SIHASIN

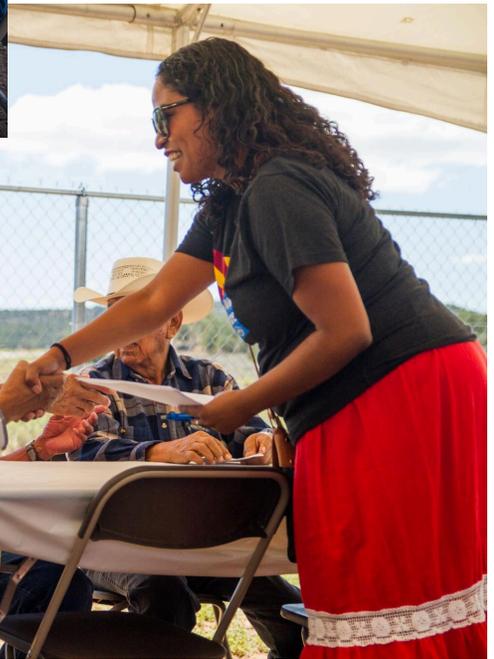
Flyer for the Forest Lake Chapter solar celebration. Drawing by Lyncia Begay, design by Stina Janssen

Images of solar celebration

Photos by Shadia Fayne Wood of Survival Media Agency, accessible on Black Mesa Water Coalition Facebook page



Shadia Fayne Wood | Survival Media Agency



Shadia Fayne Wood | Survival Media Agency

OPPORTUNITIES AND RECOMMENDATIONS FOR SOLAR ON THE NAVAJO NATION

One of the number one barriers facing Navajo families seeking solar energy is the cost^{xxx}. Many families cannot afford the high costs associated with solar power installation. While USDA funds and other subsidies help some, most rural Native households do not benefit from this assistance. Some households could afford the cost of a solar system over time if the costs were amortized, or spread out over time with a fixed monthly cost. For off-grid households that would not be saving on an existing electricity bill, this would require reallocating funds currently spent for fuel burnt for light and heat including propane, kerosene and firewood. More research is needed to determine average monthly fuel costs for off-grid households. While some residents currently lease systems from NTUA, Johns has spoken with many Black Mesa residents who say they would prefer to own their own systems. For those unable to afford the full cost of a solar system, funds from the federal government, state, or private investors would help to alleviate energy poverty on the Navajo Nation.

NET-METERING

Net-metering is a billing structure that provides cost-savings to solar customers connected to the grid. In net-metering, excess solar energy that is produced and not used immediately by the building—approximately 20-40% of energy produced—returns to the grid to be used by nearby buildings^{xxxi}. When it adds energy to the grid, the building's meter runs backwards to provide the customer with a credit. The customer is thus only billed for the “net” energy used.

While most US states have passed net-metering laws to provide consumers with the incentive necessary to invest in solar, the Navajo Tribal Utility Authority does not provide net-metering allowing customers to sell back to the grid, so a family's saving at present are limited to reducing the energy purchased from NTUA through production of locally-used solar.

BMWC believes the lack of a net-metering policy the Navajo Nation is a great barrier for households and commercial buildings seeking to install solar. This has also been a view expressed to the organization by solar companies—most of which do business exclusively in communities with net-metering. Were the Navajo Tribal Utility Authority (NTUA) to develop a net-metering policy, it would not only be the first tribal utility in the US to offer such an incentive and would facilitate greater solar development.

Some Native Nations are benefiting from net-metering policies while other tribal utility commission are exploring net-metering policies. For example, the Rosebud Sioux Tribal Utility Commission of the Rosebud Sioux Tribe in South Dakota exercises the Nation's sovereign power to regulate utilities. South Dakota is one of the rare US states without a net-metering policy. The utility commission has drafted a net-metering policy that requires the utilities that serve Rosebud Sioux tribal members, Cherry Todd and

Lacreek Electric, to pay reservation residents a fair price for the electricity they generate that is fed back to the grid^{xxxii}. Notably, this proposal includes a provision for virtual net-metering—a mechanism to spread the meter savings or sale of power derived from a large scale community renewable energy project to all community members, regardless of whether they are connected directly to that system. Furthermore, the proposal offers a feed-in tariff (FIT) system to regulate long-term contracts and grid usage between the local small-scale renewable energy producers and the large utilities. These provisions allow local communities to a stronger negotiating voice at the table with large utilities. As writes Daniel Gargan Burnette of the Rosebud Sioux Tribal Utility Commission (see footnote xxxi), FIT provisions in Europe has been shown to produce “a stable environment for producers of electricity from the wind and sun, allowing individuals, farmers and businesses to invest in these alternative energy systems.” Only with a FIT system do decentralized power producers have a reliable return on investment, an imperative for energy investments. A public hearing was held in January 2015 to gather community input on this policy^{xxxiii} **and is expected to be reviewed and adopted... Find out if it's passed.**

The Sobobo Band of Luiseño Indians' 1-MW PV project, funded by a \$1 million investment from the tribe and a \$1 million DOE grant, is another example of net-metering option. This PV plant is projected to supply 80% of the yearly energy usage of the tribes administrative center, schools and additional community buildings for estimated cost savings of \$6.4 million over 20 years. Power generated from this project, which is owned exclusively by the tribe, will flow back to the grid supplied by Southern California Edison (SCE). However, SCE will purchase the power generated from the system through a net-metering agreement. Thus, no power will go to waste and the return on investment is clear for the tribe.

The San Xavier District of the Tohono O'O Dham (TO) Nation built a solar canopy over a covered parking lot with funding from a pooled electric company \$200,000 grant in 2012. This 60 KW project had solar panels and two inverters. As Jerry Carlyle, [Vice Chairman of the San Xavier District](#), explained, the Tohono O'odham utility did not have the same net metering incentives that Tucson Electric Power (TEP) offered to solar customers. The parking lot array provides energy to a community building that had previously paid a \$1000/month electricity bill; that cost has now been reduced to \$150-250, thanks to energy savings from the solar array. While the utility does not pay for the power generated, the meter detects energy sent back to the grid, and this is deducted from the energy bill, saving costs for the community. If the electricity bill is \$0, said Carlyle, then that month's other bills, such as the water bill, would be reduced, as the utility manages water, sewer, and electric. With \$700-800 monthly savings for the community, the semi net-metering program in this case makes projects pencil out, although not to the extent of a net metering policy that would pay dispersed power producers for the energy they generate for the grid.

Since the Navajo Nation operates a tribal utility authority, the Navajo Tribal Utility Authority (NTUA), there is a distinctly close relationship between prospective residential or community energy producers and the utility that would purchase the power through net-metering. A net-metering policy along with a guaranteed long-term power purchase

contract would incentivize grid-connected households, school districts, community and Chapter buildings in their renewable energy investments.

JUST FINANCE & INVESTMENT

Credit Challenges

The issue of credit can often seem to stymie dreams of sustainable and community-based economic development for low income communities, due to the role that high interest loans have played in extracting wealth from these communities over the years. One of the challenges of grassroots organizations like BMWC and the movements we are a part of is to find ways to circumvent this barrier. How to develop a system that accommodates people without the “right” credit is one of the key challenges for just transition work and will require collaboration with investment entities that are willing to take risks.

Johns knows such entities exist and understand their willingness to be risk in order to contribute to energy justice. The challenge will be in developing a model that can sustain finance for thousands of solar installations with a return on investment that enables loans to be repaid, even while customers can own their own systems. Theories of “reinvestment” and “non-extractive finance” that have been applied elsewhere in the US provide possible solutions to some of the finance challenges faced by low-income Navajo and Hopi households. Some of these include creating entities that ameliorate financial risk for customers through a community loan fund backed up with fundraised that can provide forgiveness if a loan is unrepayable. Yet, there is ample experience managing loans among the off-grid community.

Many Navajo and Hopi households have ample experience with big work-related investments and amortizing these investments with monthly payments. For example, on the rough reservation roads, reliable trucks and trailers are a necessity for working with livestock and hauling water and other supplies. Though many households have a history of reliably making payment despite sometimes difficult economic circumstances, a credit check, the first in a set of screening protocol for households wishing to purchase solar, can still pose a barrier. Johns says more education and support is needed for individuals to have the capacity to responsibly repay loans if solar systems are purchased with credit.

Reinvestment and Non-Extractive Finance^{xxxiv}

What is divestment? Institutions, such as universities and religious organizations, invest their money into stocks, bonds and other investments to help generate income for their institution. However, some of those investments are unethical or morally ambiguous: by investing in certain corporations for example, these institutions perpetuate the injustices that are being done to people and the planet. The Fossil Fuel Divestment movement is asking universities and other institutions to divest or take their

money out of the top 200 coal, oil, and natural gas corporations and to **reinvest** those funds into just and sustainable alternatives.

What is reinvestment? Our economy often puts profit over the lives of people, communities, and our planet's future. Many industries extract natural resources and labor and funnel both of these valuable resources into the hands of the few. This is what we call an *extractive economy*. The alternative is a *regenerative economy* that centers the health and wealth of communities, shifts economic control to the people, and restores our planet. One way to shift the money from the current extractive economy to the new economy is through reinvestment campaigns. When an institution divests from fossil fuel companies, the organizers working on that campaign ask their institution to invest a certain amount of those divested funds into the reinvestment network, which supports grassroots organizations who are trying to create a new, local economy for their communities. A reinvestment network is a cooperative loan fund with a mandate to support projects that build a restorative economy.

How do reinvestment loan funds work? Reinvestment works mainly through cooperative loan funds. Several regional loan funds have already been established or are under development within financial cooperatives. This financial cooperative is governed by regional loan funds and is a central hub for them to share learnings, services and capital. These regional funds are pools of money that give out loans to cooperatively-owned enterprises that benefit the community. However, these loans are rewriting the normal rules of finance because these loans are only paid back if the cooperatively-owned enterprises are successful. If a project fails, those who asked for the loan will not have to pay it back. This means that everyone in the process is invested in it succeeding. When money is repaid to the fund from successful projects, the money is redistributed to other cooperative projects. Organizations involved with this project include Divestment Student Network, Reinvest in Our Power, Responsible Endowments Coalition, The Climate Justice Alliance and The New Economy Coalition.

Examples of reinvestment projects. There are several projects under development at present, including Renaissance Community Co-op (RCC). In the city of Greensboro, North Carolina the RCC is opening up a worker owned full service grocery store. This project will alleviate an 18-year food desert while bringing good jobs and healthy living options to a community that struggles with obesity, diabetes, unemployment and poverty. The RCC is working with several organizations to make this happen, including the Working World Fund, which is the largest loan fund in the Financial Cooperative.

Navajo Nation Investment

“The Navajo Nation should invest in off-grid solutions on behalf of tribal families to make it affordable.” –Wahleah Johns, Solar Program Coordinator

If a solar program is to thrive on the Navajo Nation, then we recommend that the Navajo Nation make significant investment in the form of dedicating a department to solar that

can help communities navigate developing solar. Presently, the Navajo-Hopi Land Commission is working on a solar project in New Mexico, but it can be difficult for communities to navigate development without a central entity monitoring and supporting all Navajo Nation solar projects. Such an entity could play an advisory role, as well as assist community groups in pulling together partnerships, or could retain partnerships rather than requiring community groups to recreate partnership formations from scratch for each new project.

This entity could ideally provide assistance to all 110 communities on the Navajo Nation to develop solar, wind, and energy efficiency to create savings for every community budget or chapter budget. With technical support and funding available through the Federal Government, the role for such an entity, perhaps housed NTUA, would be to act as a core group to coordinate and support Navajo groups making connections to the resources available.

An on-bill finance option using a combination of private and public funds, could be one way to make projects financially feasible and payment more streamlined for low-income families, with low interest rates and nominal payments on top of usual utility fees; however, for off-grid families who may not receive a monthly bill from NTUA, an on-bill finance option introduces a new bill.

Private Investment

Though the Navajo Nation government must invest in affordable solar options for Navajo residents, investment in solar from the Navajo Nation is not sufficient to meet the existing energy need of off-grid households. The wealthy Western urban hubs that have profited and ballooned thanks to the provision of cheap coal power and water extracted from Black Mesa and other Native lands are also home to many progressive and green-minded investors, philanthropists and foundations passionate about clean energy. For example, in the Bay Area, Wahleah Johns has met with numerous foundations and solar groups and has learned many are eager to support clean energy on the Navajo Nation; however, avenues to contribute or invest are not presently available. Nor do all investors have adequate familiarity with unique considerations for working in collaboration with Native Nations and communities.

Tips for Partners and Investors

1. Be clear about project roles and timeline
2. Prepare for a longer timeline than you might expect: projects must go through community approval process, an education and communication phase, and a partnership-building phase
3. Make certain the community is part of the project from the beginning

A dynamic and responsible model for collaboration that enables private investment capital to resource Navajo Nation solar customers requires a non-extractive finance model that centers Native energy customers. The Navajo Nation and most tribal governments are not set up to receive private investment for projects such as renewable energy development. To create such a partnership in an accountable fashion, the government and the private entity would need to have extended dialogue to come up with a partnership building around equity, and vision.

Organizations and institutions including the Working World, Transform Finance and the Climate Justice Alliance, the Divestment Student Network, Reinvest in Our Power, Responsible Endowments Coalition, The Climate Justice Alliance and The New Economy Coalition are exploring options to design systems whereby investors and philanthropic groups *reinvest* in Native-led power provision projects.

One of the key questions when the majority of consumers are low-income people is, “how is a return on investment generated?” and “how does that return on investment come back in a way that is sustainable and enriches, rather than impoverishes the customer and the community?”

Because entities such as tribal housing authorities as nontaxable entities, some have found success in leveraging federal tax incentives for renewable energy investments by partnering with private taxable entities. For example, the Saint Regis Mohawk Tribe’s Akwesasne Housing Authority (AHA) partnered with a private taxable entity with a tax appetite and combined state incentives and federal grants to install PV arrays and energy efficient features on 20 low income units. Writes Petersen, “A number of other tribes, including the Oneida Tribe of Indians of Wisconsin and Picuris Pueblo in New Mexico, are structuring deals based on the ‘partnership flip’ model, which allows investors to take advantage of the ITC and lets tribes avoid the up-front capital costs while retaining the option to take ownership of the project once a target return on investment is realized^{xxxv}.”

Federal Investment

While temporary grants and other assistance have been provided to NTUA from the Department of Energy, government support for rural Navajo and Hopi solar electrification, both through the NTUA and through smaller community groups, is not sufficient to meet the need.

The Department of Energy reports having invested over \$50 million in nearly 200 tribal energy efficiency and renewable energy projects and has recently earmarked an additional \$9 million to fund 15 clean energy projects in 24 tribal communities^{xxxvi}. Additionally, the DOE continues technical assistance programs under the National Renewable Energy Laboratory (NREL) and the Office of Indian Energy Policy and Programs. The DOE celebrates such investments: “Leveraging federal and state government grants, incentives, and technical assistance, many other American Indian and Alaska Native communities have amassed the resources, knowledge, and skills

needed to harness their renewable resources and deploy holistic technology solutions designed to reduce their energy costs, create jobs, and build resilience,” writes Karen Petersen of the National Renewable Energy Laboratory^{xxxvii}. While this is true, and the investment is notable, renewable energy projects are capital intensive and building out a robust program that includes job training and long-term systems maintenance may require increased federal assistance. Some Native Nations are unable to fill in the gaps and private capital may not always be suitable or available.

With climate crisis coming to Native Nations across the continent and extreme energy struggles at Standing Rock in North Dakota demonstrating tribal opposition to fossil fuel projects, public investment is crucial to facilitate robust residential and community solar for Native Nations. However, the priorities of the new Trump administration at the time of this writing demonstrate that public funds for tribal renewable energy development may decline in the foreseeable future.

On-bill finance

One such model is in the form of the Rural Energy Savings Program Act (S. 3102 /H.R. 4785), proposed to Congress in the fall of 2016. The goal of this program, as stated by Nancy Reinhart of the advocacy group Kentuckians for the Commonwealth is to “overcome the up-front costs of implementing energy efficiency and weatherization measures” for rural and low to moderate income residents^{xxxviii}. If passed, this program would create a \$4.9 billion loan program through the US Department of Agriculture’s Rural Utilities Service (RUS) that rural electrical cooperatives could access with a zero percent interest rate. Cooperatives would offer the loans to consumer member as micro-loans with low interest rates designed to be paid back primarily through energy bill savings resulting from the energy efficiency retrofits financed by the micro-loans. Thus, rural residents’ homes would benefit by gaining affordable weatherization and efficiency retrofits and would save money and pay for the retrofits directly on their power bills. A similar program has been modeled on a partnership between the power board, contractors, a community foundation, and nonprofit organizations to facilitate affordable retrofits for rural Kentucky energy customers.

For households installing solar, the Navajo Nation’s NTUA could be a natural billing mediator, factoring in the cost of a monthly payment for solar panel purchase on to customers’ existing utility bills. Such a system could generate greater interest in PV for current on-grid households by making payments easy and convenient and streamlining net-metering calculations for monthly payments.

EDUCATION, OPERATIONS AND MAINTANCE

Generally, commercial solar systems based in a Power Purchase Agreement (PPA) between a utility company and the entity that owns the solar system have a built-in operations and maintenance (O&M) agreement in the contract for the lifetime of the system, typically 20 to 30 years. “For residential systems, the installer is usually responsible for O&M but the terms differ by installer (Ardeth Barnhart, Director,

University of Arizona Renewable Energy Network, personal communication.” Maintenance on solar PV is usually very low with the inverter replacement cost being one of the only major maintenance expenditures as an inverter lasts about 10 years before it requires replacement. Barnhart mentions that with new inverters, micro inverters and smart inverters on the market, maintenance may even be less. Ardeth writes, “On the mechanical side, each installer usually designs and builds their own racking system for the PV and this can require O&M over time depending on the system...If it is tracking [the rack moves to track the sun], often this will require more O&M... for installers on the residential scale, the more customers they have, the more reliable are the O&M contracts (personal communication with Stina Janssen.”

Education is needed in the realm of both how to use the solar systems—for example, how to not overload the systems, how to regulate power usage—and making the connection between the sunlight and the power it generates. “We’re so used to putting something in the outlet and we have no idea where that power comes from or how it’s being produced. At what expense?” says Wahleah Johns. Education can demonstrate the difference—showing how energy can be produced a different way, in which energy is owned and regulated by the user.

Secondly, an on-reservation, Native-owned operations and maintenance program is good addition to the self-sufficiency that may be derived from off-grid solar. Without a functioning operations and maintenance program or local industry, a mass installation of solar systems across the reservation would be allowed to deteriorate, losing value for owners and renters. NTUA provides maintenance for its rental system and may be an appropriate home for future maintenance programs—however, if thousands of new systems were installed over the short period of several years, NTUA’s capacity would be overwhelmed. Concurrently with investment in a fund to support the installation of solar systems, investment will be required to augment a tribal or private Native-owned and operated maintenance program to service solar systems.

GREEN JOBS AND GREEN BUSINESS INCUBATOR

The goal of BMCW’s Solar Program is to develop self-sufficiency and energy sovereignty, not to create a vast jobs economy, as the jobs potential for small-scale installation and maintenance is not enormous. However, in the past, the Solar Program explored the vast potential for jobs growth in the renewable energy sector.

As BMWC wrote in a 2008 report exploring possibilities to reclaim mine sites for solar farms, “as an alternative to mining jobs, solar energy projects create 3 to 11 times as many jobs as fossil fuel or nuclear projects; so not developing solar projects misses an enormous opportunity to create more jobs, while honoring Diné and Hopi traditions.” (Source: Diné CARE, “Energy and Economic Alternatives to the Desert Rock Energy Project,” January 12, 2008, 30; *From*: Black Mesa Water Coalition, “Solar Potential on Black Mesa,” February 2011, a report about reclaiming former mine sites for solar farms.)

While a number of solar projects have been installed on the Navajo Nation and Hopi reservation, the majority have not been installed by Native solar professionals. While the Solar industry has one of the fastest-growing rates of job creation, not enough of these jobs opportunities are accessible to Native workers. A solar program on the Navajo Nation must include opportunities for training and jobs creation as well as provide opportunities for business management education to enable Native workers to start, own, and manage their own solar companies.

Furthermore, manufacturing solar systems could be another source of jobs. “Our Nation could create these products to install and maintain if we had a good system in place,” said Solar Program Coordinator Wahleah Johns.

THE FUTURE OF THE SOLAR PROGRAM

As described previously in the Executive Summary, “This report is published to document a decade of solar development research, community organizing, and education done through Black Mesa Water Coalition’s Solar Program, as the Program turns the page to a new chapter. Longtime Solar Program Coordinator, Wahleah Johns, will leave BMWC to continue her work on solar through a new enterprise called Native Renewables. BMWC will continue its education and organizing work on solar. Native Renewables intends to expand and deepen partnerships with investors and allies to support the development of affordable solar options for Navajo and Hopi communities.” The following areas of work are important for solar development moving forward.

CONTINUED EDUCATION: One of the priorities as we continue to support solar on the Navajo Nation will be amplifying our education work along with Native Renewables (NR). NR will work to reach new chapters on the Navajo Nation and will continue to organize to expose more community members to solar options. The goal will be to continue to listen to communities, to share information, and to identify where there is interest in solar.

BROAD COALITION: As NR and BMWC form complimentary projects to build up the **18,000 Home Initiative**, a plan to create programs to provide solar energy options to all off-grid homes that desire it, we will need to build a broad coalition including federal agencies, tribal agencies, communities, and investors to create workable model that can tackle the challenges of rural clean energy development.

FURTHER RESEARCH: As outlined in this report, one of the key barriers to solar development that includes community participation and is accessible and affordable to low-income families, is the question of finance. How to make solar affordable and simple to pay for, use, and maintain, is a question that requires further research and experimentation. One question in particular which should be explored by further research the range of monthly payments that would be affordable for low-income families desiring solar, and the optimal form billing should take. Additionally, research capacity is needed to support community efforts to prioritize locating and mapping the approximately 18,000 households without power across the Navajo Nation.

CONCLUSION

As the issues of climate and carbon grow every more polarized, the fate of many communities and the health of ecosystems hangs in the balance. With the possibility the Navajo Generating Station may close due to the dropping price of coal in 2019, the future of solar is ever more important, both for residents of the Nation and for a world which must transition away from coal to renewables. The Black Mesa Solar Program has made up one bright star in a constellation of solar development experiments and alternatives on the Navajo Nation and globally. The program has provided community education to Black Mesa communities interested in solar through numerous forums, community meetings, celebrations, and through the process of developing the Forest Lake Chapter House project. Throughout a decade of work, the Black Mesa solar program has changed the landscape and the realm of possibility for affordable and accessible solar for Black Mesa communities. However, the work has only begun.

The future of affordable and community-centered solar will require a values commitment to centering cultural traditions and community decision-making so that low income people have a stake in how solar becomes an integrated technology across grid-connected as well as off-grid communities. This values commitment must be infused into each element that we believe will make affordable solar more viable on the Nation: (1) investment with collaborative and accountable partnerships between private and public, non-tribal and Nation government entities; (2) net-metering that consistently improves to make the purchase of solar systems more cost effective for communities and households; (3) a green jobs incubator to train a larger local renewable energy workforce; (4) an operations and maintenance system integrated into the solar program such that systems are well maintained by local technicians; (5) continued education to increase the visibility and literacy with solar; and (6) continued research to tackle the barriers that continue to stand in the way of solar, including research about the payment capabilities and preferences of off-grid households.

With these components, we envision a vibrant and sustainable energy future, in which households and communities produce their own power locally, with limited carbon output, higher air quality, and a very low contribution to climate change. We also envision the sovereignty and self-reliance that ownership of the renewable energy infrastructure will represent for rural off-grid as well as grid-tied communities. Black Mesa Water Coalition looks forward to continuing to work together with partners on the Navajo Nation and our members and communities as we move towards this future together.



Black Mesa Water Coalition Just Transition Summer Fellows, Flagstaff, AZ; summer 2016 (photo by Stina Janssen)

ENDNOTES

ⁱ Begay-Campbell, Sandra (2005) Proceedings from Arizona Governor's Tribal Energy Meeting: *Native American Sustainable Energy Systems - Navajo Solar Electric Case Study*. Arizona.

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- ^{xxxv} Source: <http://solartoday.org/2016/07/a-new-path-to-prosperity-in-indian-country-exploring-opportunities-for-clean-energy-development-on-tribal-lands/>

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