Mashpee Wampanoag Tribe
Solar Feasibility Study

July 2018

Conducted by

SELF-RELIANCE

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Mashpee Wampanoag Solar Resource Assessment

Introduction

Self-Reliance Corporation was contracted by the Mashpee Wampanoag Tribe to perform a feasibility study for the development of solar photovoltaic (PV) systems on Tribe-owned land as part of a funded proposal through the Bureau of Indian Affairs' Energy and Minerals Development Program. Self-Reliance was responsible for the resource analysis. Baker Tilley was responsible for conducting the financial analysis for the solar as part of their Tribal Utility feasibility study. Self-Reliance and Baker Tilly reported out the findings of their respective analyses to the community at the Wampanoag Tribal meeting in June 2018. Self-Reliance also reported out to the Wampanoag Community Development Corporation and Housing Office numerous times throughout the project to solicit feedback and discuss options for siting and understand more fully the current and future use of various parcels of land we evaluated for photovoltaics.

As part of the study, Self-Reliance prepared this solar resource assessment document using Helioscope, solar development software, to assess the approximate available land area and production potential of several sites owned by the Mashpee Wampanoag Tribe. Staff also made physical visits to the site to analyze the height of trees, inspect for other infrastructure at the site that would need to be accounted for in the analysis of solar resources and location of solar installations.

The three sites included in this report are the Wastewater Treatment Facility and adjacent disposal field located at 184 Meetinghouse Road, the Department of Public Works facility and adjacent farmland located at 213 Old Mill Road, and the Tribal Community Center and Headquarters located at 483 Great Neck Road South.

Additionally, information is included regarding the potential for solar PV systems at the planned First Light Resort and Casino in Taunton, MA. However, with the project in the pre-construction phase at the time we began the analysis, it is difficult to perform a solar resource assessment at this time. As a result, the potential for solar PV at the First Light Resort and Casino is scored separately from the potential from the Wastewater Treatment Facility, the Department of Public Works/Farm, and the Tribal Headquarters. At the time the final draft of the report was written the Tribe had put the Casino project on hold. Therefore, only basic figures appear in this report.

The total estimated potential of these three Mashpee sites (not including the First Light Resort and Casino) is roughly 1.27 MW (see **Table 1**). This serves as an excellent opportunity for the Mashpee Wampanoag Tribe to achieve several of the goals outlined in its 2015 Climate and Energy Action Plan and 2016 10-Year Energy Strategic Plan, including economic growth for the Tribe and the generation of 100% of the Tribe's electricity on Tribe-owned land.

Table 1: Grand Totals (WWTF, DPW/Farm, Tribal Headquarters) *note: does not include the planned First Light Resort and Casino	
Total Estimated Solar Resource (sq. ft.):	122,225 sq. ft.
Total Estimated kW Potential (assuming 96 sq. ft. /kW):	1,271.75 kW / 1.27 MW

Site 1: Wastewater Treatment Facility

The Mashpee Wampanoag Wastewater Treatment Facility (WWTF) is located at 184 Meetinghouse Road, Mashpee, MA 02649 (**Figure 1**). The facility is currently in active mode, but will be used extensively once the adjacent housing development is completed. This study identified three potential locations for solar development at this site, including the roof of the WWTF (**Figure 2**), the WWTF parking area (**Figure 3**), and the large open leaching field adjacent to the WWTF (**Figure 4**). In total, the three potential development locations for this site represent a combined 17,000 square feet of space, which could support up to 179 kW of solar capacity.

Table 2: Wastewater Treatment Facility (WWTF)	
Address:	184 Meetinghouse Road, Mashpee, MA 02649
Total Estimated Solar Resource (sq. ft.):	17,242 sq. ft.
Total Estimated kW Potential (assuming 96 sq. ft. /kW):	178.75 kW

Figure 1. Potential solar developments at the WWTF and adjacent disposal field. Housing development will be located to the north of the WTTF and the northwest of the disposal field.

Figure 2. Potential solar development on WWTF roof. The roof face south-southeast and has a small amount of area for solar PV.

Estimated Solar Resource (sq. ft.): 1,000 sq. ft. (approximately 50'x20')

Estimated kW Potential (assuming 96 sq. ft. /kW): 10 kW

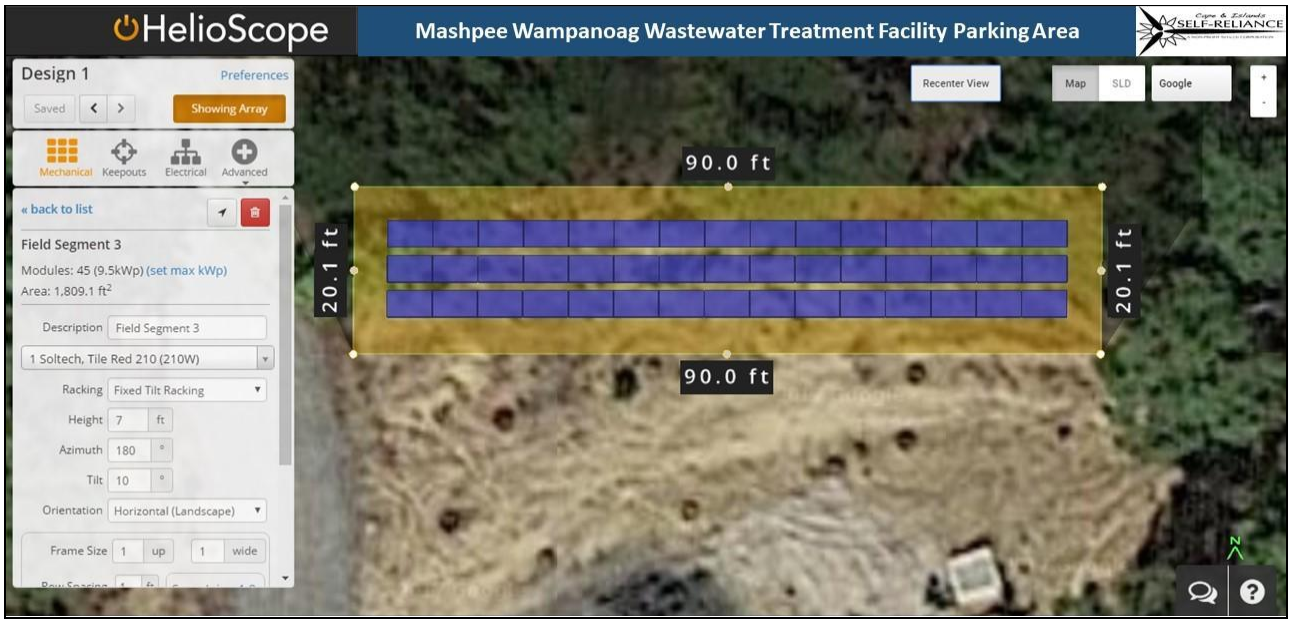

Figure 3. Potential solar development at WWTF parking area. Some small tree clearing will likely be required.

Estimated Solar Resource (sq. ft.): 1,800 sq. ft. (approximately 90'x20')

Estimated kW Potential (assuming 96 sq. ft. /kW): 18.75 kW

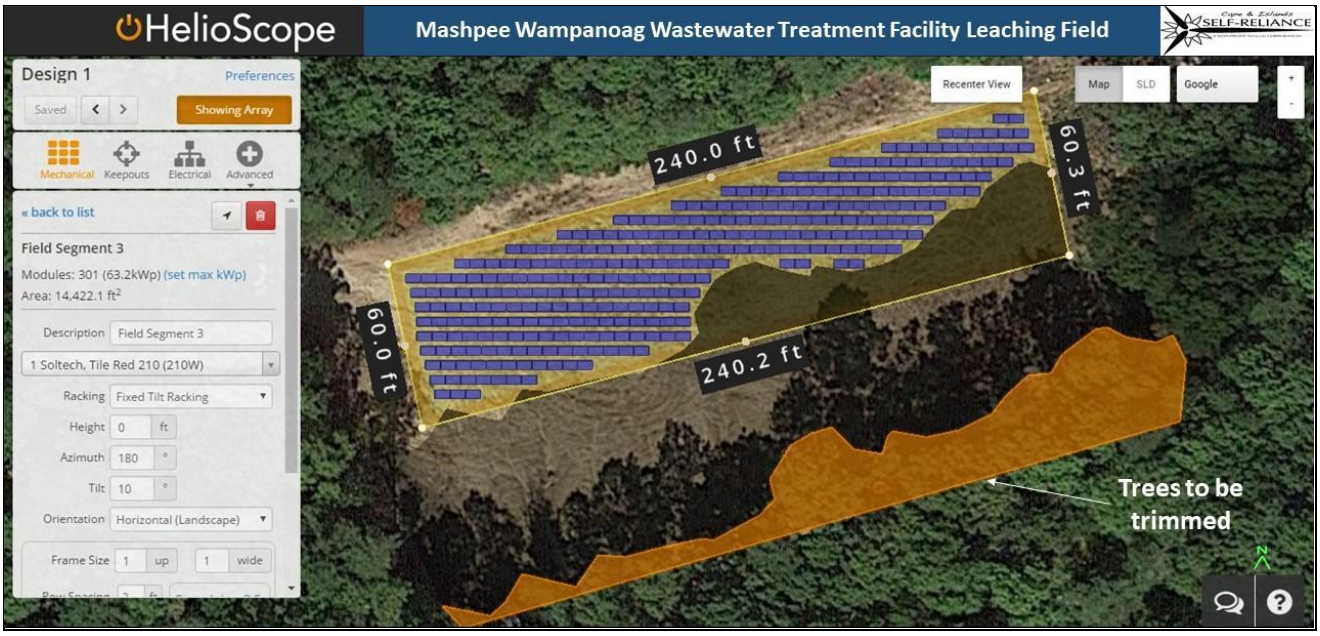

Figure 4. Potential solar development at the leaching field w/ 25ft. keepout from tree line. This site will likely require a trimming of the trees on the southern edge of the site.
Estimated Solar Resource (sq. ft.): 14,422 sq. ft. (approximately 240'x60')
Estimated kW Potential (assuming 96 sq. ft. /kW): 150 kW

This leaching field is a space for many other potential uses, so Tribal decision-makers need to determine how the space will be utilized and how PV plays a role in its development. If a playground or amphitheater were to be built on the site, a PV canopy structure or structures could be integrated into the overall design

Site 2: Department of Public Works & Farm

Self-Reliance visited the Mashpee Wampanoag Tribe's Department of Public Works facilities and adjacent farmland located at 213 Old Mill Road in Mashpee, MA 02649 (**Figure 5**). This area, particularly the open farmland, is very well-suited for solar development. The large DPW building (formerly a barn) has a large south-facing roof, and is already equipped with a small solar array with a capacity of roughly 8 kW (**Figure 6**).

The farmland adjacent to the DPW facilities represents an excellent opportunity for a large solar array. The farm area currently serves several uses; as a storage area for sand used in the neighboring Willowbend golf course (**Figure 7**), a location for two large loam piles that the Tribe frequently uses and wishes to remain in place, and as a dumping ground for woody debris (**Figure 8**). The DPW primarily uses this multi-purpose area and overall best use cases must be evaluated by Tribal decision-makers to determine the siting of PV at this site, which would necessitate the removal of the sand piles and woody debris, and potentially the relocation of the loam piles.

In total, the expansion of the PV system on the DPW Building roof coupled with solar development in the large farmland area could result in an estimated 583.5 kW of capacity across over 56,000 square feet. This is an excellent opportunity for the Tribe to develop solar PV.

Table 3: Department of Public Works (DPW) Building & Adjacent Farmland & Small Barn	
Address:	213 Old Mill Road, Mashpee, MA 02649
Total Estimated Solar Resource (sq. ft.):	61,958.4 sq. ft.
Total Estimated kW Potential (assuming 96 sq. ft. /kW):	638.5 kW

Figure 5. Potential solar developments at Mashpee Wampanoag DPW and adjacent farmland.

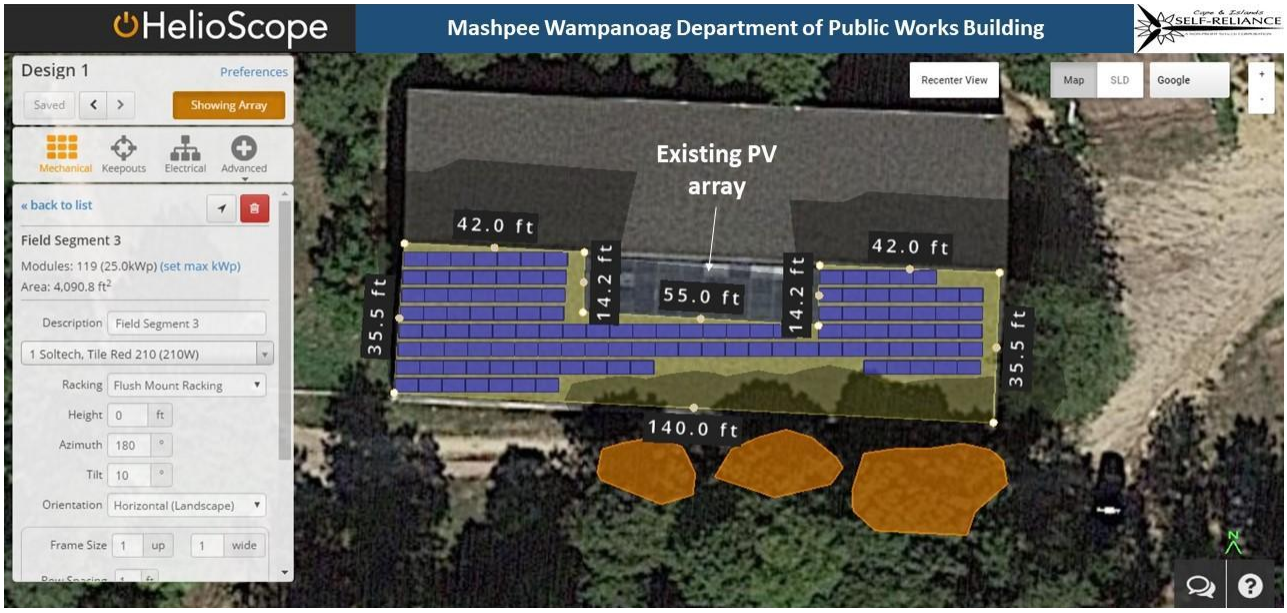

Figure 6. Potential expansion of existing rooftop solar on Mashpee Wampanoag DPW building. The site already features a ~8 kW system, and with the rest of the roof space utilized, could potentially support a 50 kW system. However, this site will likely require trimming of the three trees alongside the building.

Estimated Solar Resource (sq. ft.): 4,090 sq. ft. (approximately 140'x35')

Estimated kW Potential (assuming 96 sq. ft. /kW): 42 kW

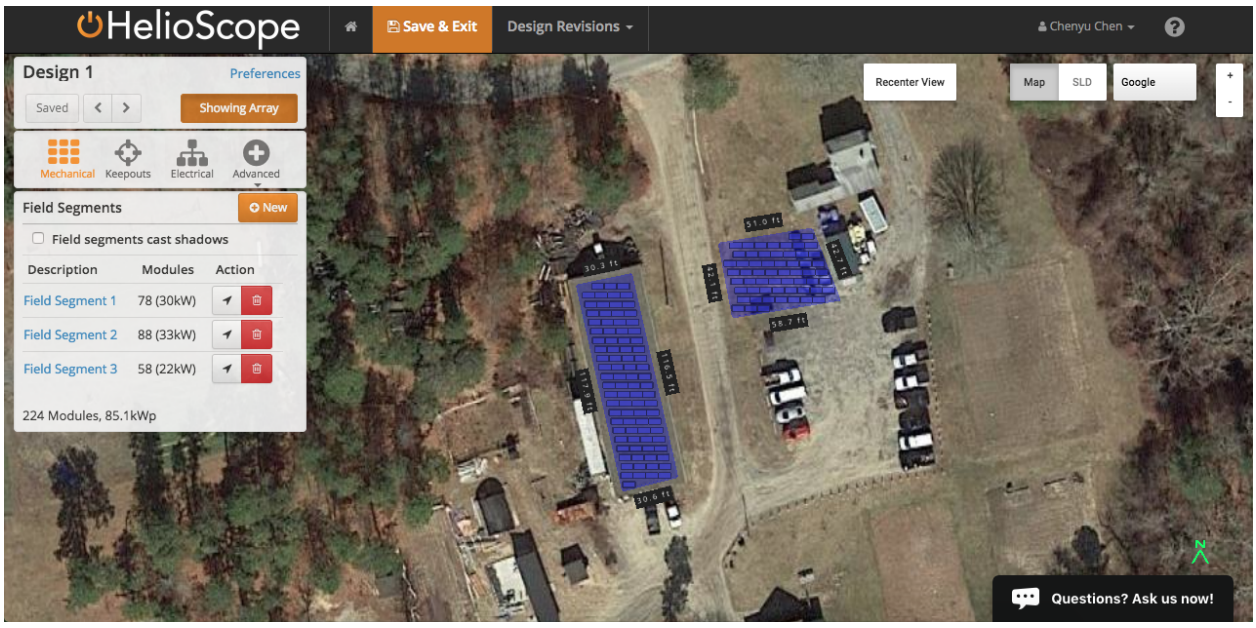

Figure 7. Small Barn and Ground-mounted array adjacent to garage and parking lot.

Estimated Solar Resource (sq. ft.): 3564.6 sq. ft. for the roof of the small barn and the space for the ground mounted array shown to the left of the garage is 2303.8 sq. ft.
Estimated kW Potential (assuming 96 sq. ft. /kW): The barn roof can accommodate 33.4 kW. The ground-mounted array shown is 22 kW. There is greater potential for a canopy of sorts over the parking lot at the farm, but this depends on what the multi-use plans are for the parking lot space is.

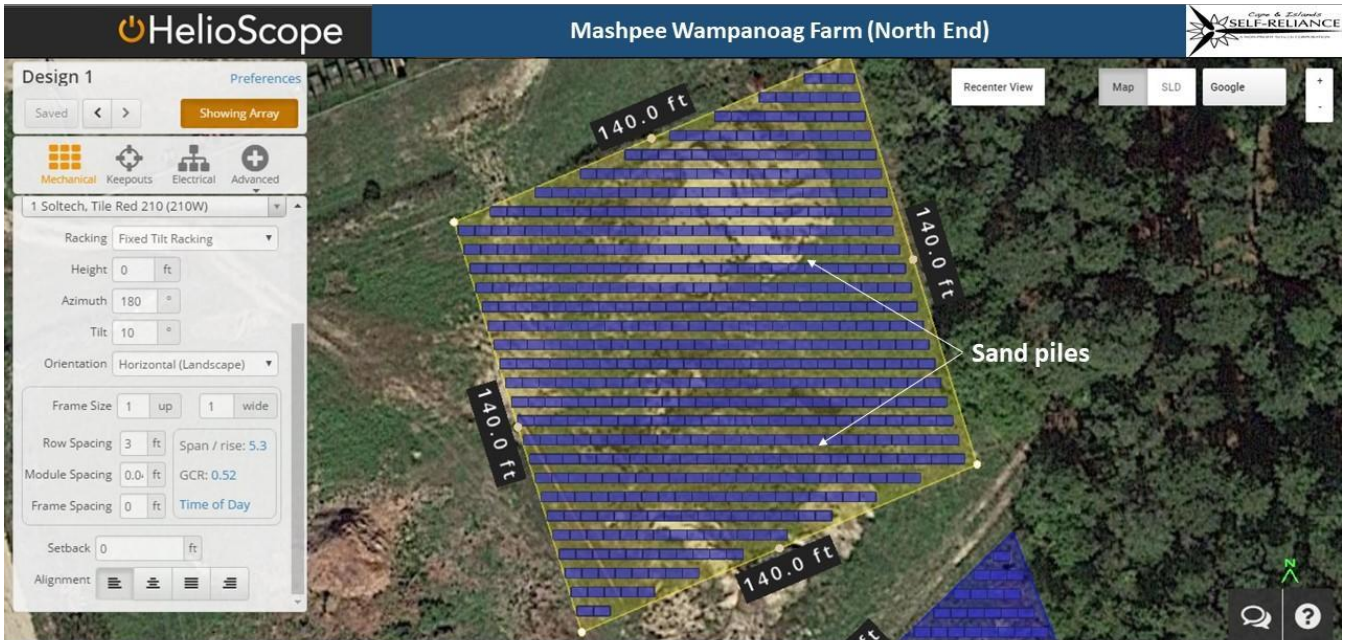

Figure 8. Potential solar development on farmland adjacent to Willowbend golf course. This site will require the relocation of two large sand piles that are currently being used to supply the adjacent Willowbend golf course.
Estimated Solar Resource (sq. ft.): 19,600 sq. ft. (approximately 140'x140')
Estimated kW Potential (assuming 96 sq. ft. /kW): 204 kW

Figure 9. Potential solar development on farmland adjacent to loam pile. This site will require the clearing of disposed woody material currently located on the site, and the consolidation of the southeastern loam pile into the southwestern loam pile would be beneficial.
Estimated Solar Resource (sq. ft.): 32,400 sq. ft. (approximately 140'x250')
Estimated kW Potential (assuming 96 sq. ft. /kW): 337.5 kW

Site 3: Tribal Community Center and Headquarters

The third area examined in this study was the Mashpee Wampanoag Tribal Community Center and Headquarters, located at 483 Great Neck Road South in Mashpee, MA 02649 (**Figure 9**). This location boasts a large, open parking area over which solar canopies could be installed. These canopies would have the benefit of being located close to the load it is serving (the Tribal Headquarters), resulting in reduced transmission costs (**Figure 10**). Additionally, the canopies would provide several other benefits, such as open space preservation and protection of cars in the parking lot.

Furthermore, under the recently-announced Solar Massachusetts Renewable Target (SMART) Program, solar canopies are slated to receive an additional incentive above the base incentive for solar installations. However, these regulations are not final and are still subject to change.

In addition to solar canopies, the Tribal Community Center and Headquarters could potentially host a ground-mounted system towards the rear parking area (**Figure 11**). The combined solar canopies and ground-mount system could result in over 700 kW of capacity. With the many benefits of installing solar canopies, this site should be a priority for solar development by the Tribe.

Table 4: Mashpee Wampanoag Tribal Headquarters

Address:	483 Great Neck Road South, Mashpee, MA 02649
Total Estimated Solar Resource (sq. ft.):	67,865.8 sq. ft.
Total Estimated kW Potential (assuming 96 sq. ft. /kW):	704 kW

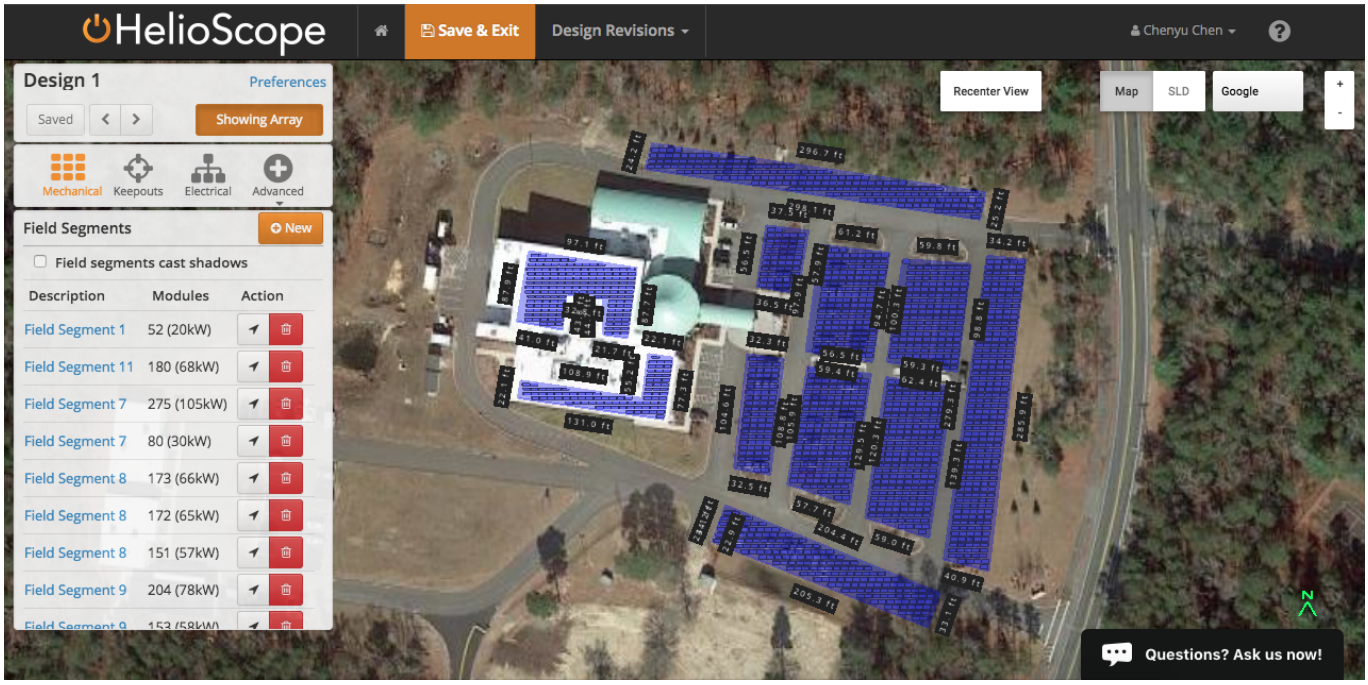

Figure 10. Potential solar developments at Mashpee Wampanoag Tribal Headquarters, featuring a medium-sized roof-mounted solar installation and accompanied by a substantial parking lot canopy system.

Estimated Solar Resource (sq. ft.): Roof: 11,217.5 sq. ft.. Parking lot: 56,648.3 sq. ft.
Estimated kW Potential (assuming 96 sq. ft. /kW): 114 kW on the roof and 590 kW in parking canopies for a combined potential of 704 kW.

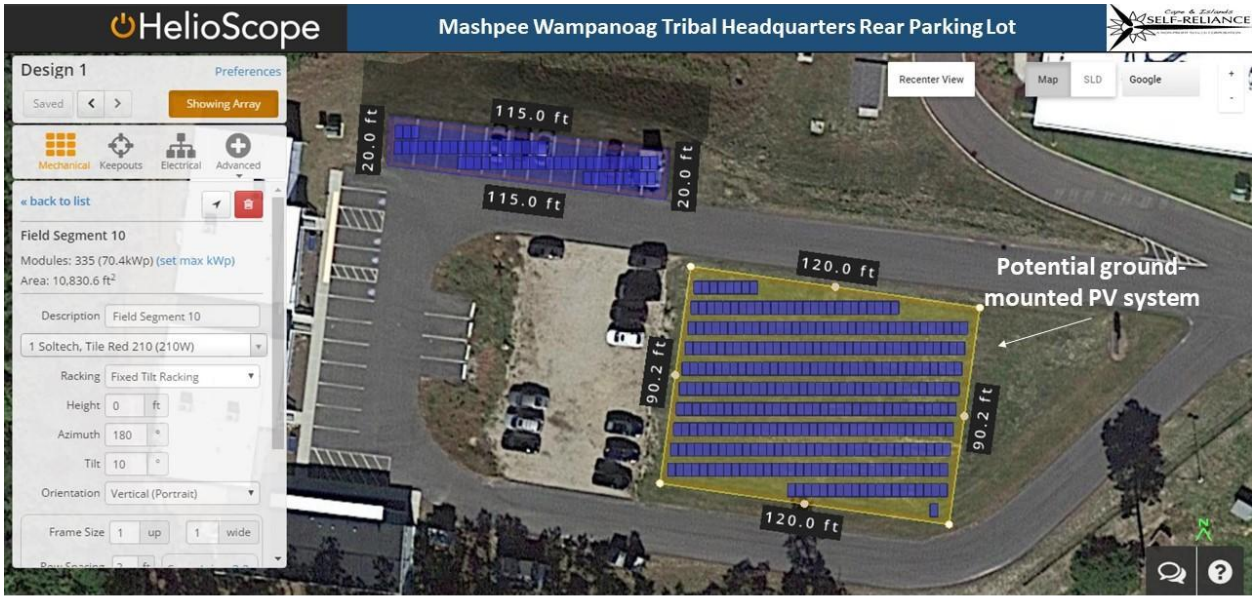

Figure 11. Potential solar canopy development in the rear parking area with accompanying ground-mount system. *This property is leased out by the Tribe to another entity, so it is not on a high priority list for development.*
Estimated Solar Resource (sq. ft.): 13,132 sq. ft.
Estimated kW Potential (assuming 96 sq. ft. /kW): 137 kW

In addition, we had been asked to explore the feasibility of utilizing WholeTree® support structures for the carport canopies envisioned in the Tribal Government Center parking lot.

These structural trees are sustainably harvested from forests and consist of white oak and black locust. They offer a suitable alternative to structural steel and are rated for heavy snow and high wind loading which structures must be built to withstand in Mashpee.

The costs quoted from WholeTree® for the support structures, based on a per watt basis, is in line with the current quotes we have obtained from the marketplace for traditional steel structures to support PV canopies.

WholeTree® offers a fully engineered post and beam design for their parking canopy options. The cost for the post and beam structure per watt is between $1.27 and $.90 depending upon the square footage of the PV area to be supported by the canopy structures.

An example of their post and beam design is seen below:

The cost per watt for the cantilevered canopy support structure is between $1.04 and $.70 per watt.

Site 4: First Light Resort and Casino

The Mashpee Wampanoag First Light Resort and Casino is a planned entertainment complex to be located in Taunton, MA. The facility will include a casino, three 300-room hotels, an events center, several dining locations, retail space, a water park, and parking for approximately 5,657 vehicles in both garage and surface lots. The First Light Resort and Casino, once operational, will consume an enormous amount of energy. Therefore, it is recommended that options for on-site renewable generation be considered, so that fewer fossil fuels may be burned to power the facility.

In the Project First Light Final Environmental Impact Report (December 2014), the potential for solar PV was examined (Project First Light Final Environmental Impact Report, pp. 5-31). Rooftop solar PV potential was examined for the casino podium and the hotel tower, where shading was minimal and without competing uses. It was estimated that up to 800 kW of solar PV could be installed on the roofs of the casino podium and hotel tower (**Figure 12**). These systems were estimated to produce over a gigawatt-hour (GWh) of electricity annually, and had a payback period of 10 years each.

Table 5: First Light Resort and Casino	
Address:	Taunton, MA
Total Estimated Solar Resource (sq. ft.):	48,893 sq. ft.
Total Estimated kW Potential (assuming 96 sq. ft. /kW):	2,166 kW / 2.17 MW

Parameter	Casino Podium	Hotel Tower
Number of Panels	3039	185
Panel angle	20 degrees	20 degrees
Installed capacity	760 kW	46 kW
Annual Generation	984 MW hr/yr	59 MW hr/yr
Potential GHG reduction	356 short tons CO2	21 short tons CO2
Installed Cost:	$3,040,000	$184,000
Payback period	10 years	10 years

Figure 12. Estimated production and payback period of rooftop solar PV installations at the planned First Light Resort and Casino in Taunton, MA. Originally from the Project First Light Final Environmental Impact Report (2014), Epsilon Associates, Inc.

The potential for solar canopies was also examined in the Final Environmental Impact Report. Epsilon Associates, Inc., the consultant who developed the FEIR, examined three large parking lots for potential canopy development. These three parking lots comprise a total of 326,600 square feet of parking area, of which an estimated 226,700 square feet could host solar canopies. It was estimated that up to 1.36 MW of capacity could be installed in the parking lots, resulting in over 1.5 GWh of annual generation and a payback period of 11 years (**Figure 13**).

Parameter	Parking Lot Canopies
Parking lot total area	226,700 square feet
Amount of area potentially available for solar panels	50%
Panel angle	0 degrees*
Panel rating, estimate	12 W/square foot
Installed capacity	1360 kW peak DC
Annual Generation	1582 MW hr/yr
Potential GHG reduction	569 short tons CO2
Installed Cost	$5,440,800
Payback period	11 years

Figure 13. Estimated production and payback period of solar canopy installations at the planned First Light Resort and Casino in Taunton, MA. Originally from the Project First Light Final Environmental Impact Report (2014), Epsilon Associates, Inc.

With a significant solar PV potential and a large load at the First Light Resort and Casino, the Mashpee Wampanoag Tribe should further pursue solar development at this site. It will help mitigate the greenhouse gas (GHG) emissions associated with the development, and helps the Tribe achieve its strategic energy goals.

Site 5: Housing Development

Another site for solar PV development that is not thoroughly explored in this assessment is the planned housing development off of Meetinghouse Road in Mashpee, MA. The 44-house development, in its current plan that we had for evaluation purposes, only features a handful of homes facing southward (**Figures 14-15**). If the homes were realigned to face southward, a PV system could be installed on each roof, providing numerous benefits to the housing community and the Tribe as a whole. It is recommended that the Tribe examine its plan for the housing development, and, if possible, realign more homes so that they are facing southward.

In April 2018, we met with the Housing Director and other Tribal members to discuss shifting some of the homes' positions on the lot to accommodate solar on the roofs or to consider

awning mounted options. We were asked to provide images to be presented to the Housing Committee to see if there might be interest in enabling solar at a future date.
Below are the images that were provided to illustrate what roof-mounted PV might look like:

Some examples of what ground-mounted PV could look like:
There are a number of options for ground-mounted solar installations.
This sort of installation is a great option when there are spaces relatively close to the electrical load where there is suitable amounts of sunlight throughout the year to accommodate a solar installation. Many instances exist where the ridgeline of the roof is not oriented correctly, there may be trees shading the roof and a sunny location in the yard is more suitable for the installation of the solar system. Typically, these installations cost up to $1.00 more per watt due to the increased labor and parts necessary to install them. Trenching needs to be done to bring the electrical line back from the PV system to the electrical panel. Footings or other anchor systems to keep the PV array in place on the ground must be installed and that has a cost where most roof-mounted systems are cheaper as they are using the roof structure to support the array.

Below are examples where arrays can be mounted on a pole.

These sorts of ground mounted arrays are suitable in spaces where there are multiple uses for the land that need to be balanced with the solar. Pole mounted PV enables animals to graze, kids to play, mowing of grass, etc without having the surface area be completely dedicated to the solar arrays.

Below is an example of a ground-mounted array that is supported on racking, which sits on concrete footings dug into the ground.

These mounting technologies are good for areas where there are no competing interests for the use of space.

Below are some examples of what awning-mounted PV could look like in a residential setting.

This example demonstrates a PV array that is acting as a roof-like awning over a porch area where it is able to provide shade and shelter on the porch while generating electricity. This sort of installation is nominally more expensive than a roof-mounted array. But it should be noted that the awning provides a value to the user that is in addition to the generation of electricity.

This example demonstrates the option of installing a PV array on the side of the home as the roof appears to be unsuitable for PV.

Some examples of what a smaller residential PV parking canopy could look like:

Or another example using the WholeTree® canopy system, which can be sized appropriately for the parking area and number of cars needing space.

Another feature that PV parking canopies can incorporate is electric vehicle charging stations. With an increase of electric and plug-in hybrid vehicles on the road, having charging capacity at the sites where PV parking canopies are sited makes a great deal of sense and offers the synergistic benefit to having cars charging from the sun, while it is shining, but also allowing people to park under the canopy to remain in the shade of the sun, or out of the rain and snow.

Currently, Eversource is offering to cover the cost and conduct the work of the trenching and laying of conduit and wire up to the point of the charger pad as part of their Make Ready EV

program. Customers are then responsible for purchasing the EV charging station and having it installed.

The Massachusetts Department of Energy Resources' Clean Cities program offers incentives and rebates for the electric vehicle charging stations. Most entities that offer EV chargers are not offering the electricity for free. There are online payment options for users to charge their vehicles and map out routes between chargers.

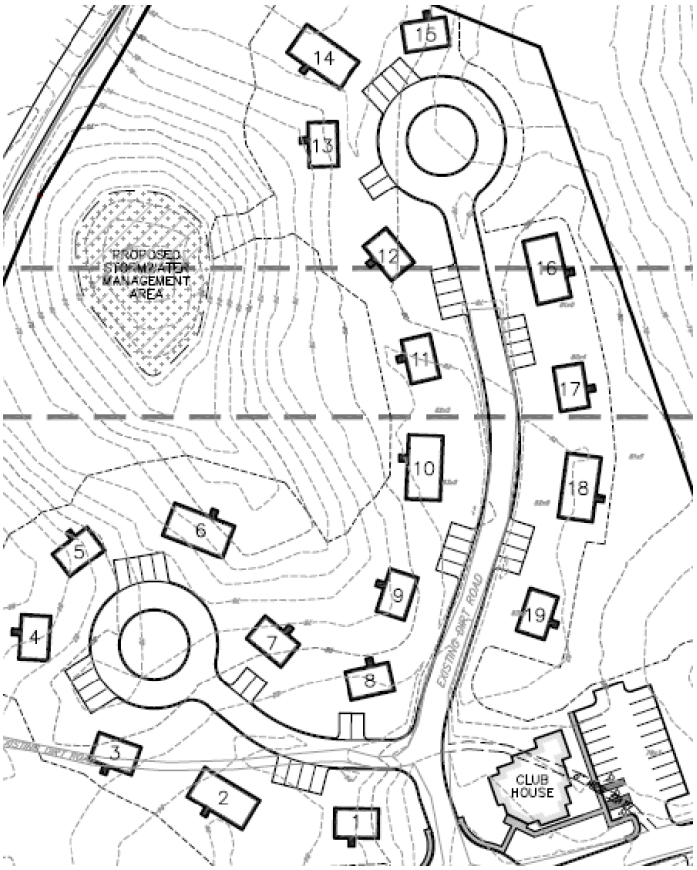

Figure 14. North side of planned housing development off of Meetinghouse Road in Mashpee, MA. Few houses are currently facing north-south, which is the best roof orientation for rooftop solar PV.

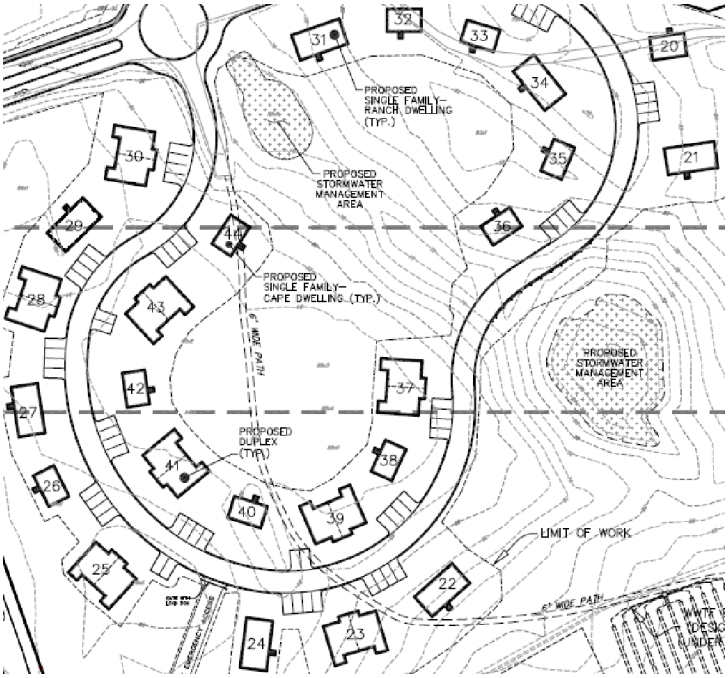

Figure 15. South side of planned housing development off of Meetinghouse Road in Mashpee, MA. Few houses are currently facing north-south, which is the best roof orientation for rooftop solar PV.

The housing development will host 34 unit with a total of 107 bedrooms overall:

- 13 cape-style homes, each with four bedrooms (52 total bedrooms)
- 13 ranch-style homes, each with three bedrooms (39 total bedrooms
- 8 duplexes, each unit having 2 bedrooms (16 total bedrooms)

According to the Massachusetts Department of Energy Resources' Energy Markets Division, the cost to heat a home using electricity (electric resistance heating, which is very inefficient) was less than heating with natural gas for the heating season of 2017-2018.

Natural Gas Massachusetts	Winter Of							
Massachusetts	2012/13	2013-14	2014-15	2015-16	2016-17	Five Year Average	2017-18*	%Change from Last Year
Consumption (therms)	*769*	*824*	*855*	*593*	572	723	605	6%
MA EIA Wtd Price($)	*$1.21*	*$1.47*	*$1.02*	*$1.09*	*$1.30*	$1.20	*$1.40*	7%
Expenditures	*$930*	*$1,212*	*$873*	*$646*	$746	$881	$846	13%
adjusted US EIA consumption based on MA vs. Northeast HHD Difference								
*Based on gas utility company filings with the MA DPU								

	MA Avg Residential Winter Of							
Electric (Non Municipal)	2012/13	2013-14	2014-15	2015-16	2016-17	Five Year Average	2017-18*	%Change from Last Year
Consumption (kWh)	*3173*	*3271*	*4071*	*2909*	*3192*	*3164*	*3374*	6%
Avg c/kWh	*14.60*	*17.32*	*20.05*	*19.42*	*19.67*	18.21	*21.86*	11%
Expenditures (heat portion only)	*$463.28*	*$566.74*	*$816.26*	*$565*	$628	$594.22	$738	17%
* MA Utility Filings with DPU								

https://www.mass.gov/service-details/mass-projected-household-heating-costs

Considering energy efficient cold climate heat pumps to provide heating, cooling and dehumidification for the tribal housing units is recommended as they are very energy efficient, quiet and are incentivized through the Mass Save program as well as the MA Clean Energy Center and MA Department of Energy Resources.

The energy efficient cold climate heat pumps work well with PV systems and coupled with energy storage systems, they provide much needed energy resiliency for vulnerable residents when the power is out. It is recommended that this option be explored for the housing unit.

Permitting

Based on research conducted, if federal funds, either in the form of loans or loan guarantees, or grants, are utilized in a tribal project, then permitting and notification of proposed projects trigger National Environmental Policy Act (NEPA) review and compliance.

It is recommended that the Bureau of Indian Affairs (BIA) be consulted to verify the process for each project. The BIA also has the ability to determine if an existing NEPA filing for a project site covers the additional proposed project, in this case, installing solar on tribal lands.

Under the umbrella of NEPA, the following agencies and policies guidelines must be followed:

- National Historic Preservation Act for Historical Properties
- Clean Air Act
- Clean Water Act
- The Endangered Species Act Threatened and Endangered Species
- CZMA-Coastal Zone/Barriers
- Wild Scenic Rivers
- EO 12898 Environmental Justice
- EO 11988 Floodplains
- EO 11990 Wetlands
- RCRA-Facilities in Use
- US Fish & Wildlife

Assessment of whether there are environmental impacts, both direct impact to the land and resources must be carticulated as well as if there are indirect impacts associated with the potential development.

A desktop analysis of the Mashpee Wampanoag properties indicated that none of the properties evaluated for this study are located in the FEMA maps as areas located in flood zones and therefore the development of solar should not trigger EO 11988 Floodplains.

Permitting requirements for solar on tribal lands trigger an environmental assessment through the BIA.

For systems that are being mounted to a structure and are 10 kilowatts and under, there is a categorical exclusion.

For PV systems above 10 kilowatts and having any impact or disturbance to the ground, a Class I environmental assessment is necessary.

The BIA should be consulted for each project to provide additional feedback and evaluation of method to proceed with permitting.

Other permits may be necessary from the Mashpee Wampanoag Tribe to begin a project.

Financing Options

While this aspect was part of the Baker Tilly portion of the study, we have a short summary included below.

There are numerous options for financing solar projects that the Tribe should evaluate and in order to make an informed decision.

One common option is third-party financing is where a third party is solicited to design, build and own the solar installation for a specific duration of time. Many contracts are for 20 years. The Tribe would negotiate a price per kilowatt hour for the contract and take advantage of the lower-than-retail price for electricity, while the third party takes advantage of the tax credits and the accelerated full depreciation that is allowed for renewable energy assets.

Another option is for the Tribe to raise funds through grants and other internal means to hire a company to design and build the solar installation, but the ownership of the asset and the full value of the cash flow associated with the project remains with Tribe.

There is a “flip” model is a financial model that may used, which has usually two or more partners. The partner with the capital and tax appetite is considered the limited partner, while the general partner (the Tribe in this case) has less capital and low tax appetite. An agreement is created that identifies the internal rate of return that the limited partner wants to achieve in a specific number of years and for the time when the project ownership “flips” over to the general partner to receive the full benefits of the asset. This model was done with a local non-profit organization in Buzzards Bay that installed a large PV system and had a board member that was able to be the limited partner with the tax appetite.

It should also be noted that the Bureau of Indian Affairs website indicates that tribes have the ability to tax tax credits: https://www.bia.gov/as-ia/ieed and this link offers the IRS ruling on a specific example where the tribe was eligible to realize the tax credits related to an energy project: https://www.irs.gov/pub/irs-wd/1310001.pdf

Utility Interconnection:

Interconnection of renewable energy generation to Eversource's infrastructure is a process. This process can be costly and take a great deal of time, which in the scheme of developing a project can become a fiscal burden if the process takes longer than anticipated.

Eversource's substation # 946, located at 21 Orchard Road in Mashpee, has been recently undergone substantial upgrade.

For any photovoltaic system to be connected to the Eversource grid, an interconnection agreement must be filed. For systems 3 kilowatts and greater in nameplate capacity, a fee is required.

For systems above 500 kW nameplate capacity, a pre-application must be filed and an interconnection study must be conducted by Eversource before permission is granted to interconnect.

Once the specific projects have been identified for each site and nameplate ratings have been determined, the pre-development work of submitting the specific equipment details to the utility takes place.

Many questions pertaining to the benefits of, potential barriers to interconnection of Tribal Utility-owned equipment to Eversource may be answered by the Baker Tilly team through their analysis.

The value of exploring a micro-grid for the housing development on Meetinghouse Road offers potentially great value to the residents of the neighborhood during times when the grid goes down, but also has the potential to offer financial benefits to the Tribal Utility during times of peak electricity demand.

The Tribal Community and Headquarters Building is an ideal facility to designate as a shelter and have critical loads be run off of a storage system being fed by a renewable energy system for as long as possible to minimize the use of a fossil fuel generator.

The value of an energy storage system at the 483 Great Neck Road site goes well beyond serving to power critical loads when the grid is down. Energy storage systems offer additional financial value for helping to reduce peak demand in the region.

Pre-development studies can help determine costs and values of installing energy storage systems at desired locations owned by the Tribe.

Conclusion

The Mashpee Wampanoag Tribe has good potential for solar development on its land. Between the Wastewater Treatment Facility and adjacent leaching field, the Department of Public Works and adjacent farm, the Tribal Headquarters, and the planned First Light Resort and Casino, the Tribe will be able to generate a significant amount of electricity from both rooftop solar PV and

solar canopies. The development of solar PV will help the Tribe meet several of its strategic energy goals outlined in its 2015 Climate and Energy Action Plan and the 2016 10-Year Energy Strategic Plan, and will position the Tribe as an example of sustainable energy development.

Clearly, the costs associated with the installation of large scale solar are not insignificant. Massachusetts offers incentives through the SMART program, which is replacing the SREC program, which help to provide incentives for solar installations across the Commonwealth.

As the Baker Tilly cost analysis indicates there are ranges in payback scenarios depending upon the financial/ownership/development model chosen. There are numerous grant programs at the federal level that help defray the cost of development. If the farm at the Sampson's Mill Road address is still deemed an agricultural property in the eyes of the state, then the Massachusetts Department of Agriculture energy grant program offers additional incentives.

List of Potential Projects in Order of Priority-based on capacity

High Priority

- 483 Great Neck Road South- Tribal Community and Government Center roof and parking canopies, which has the potential to accommodate ~704 kW of capacity.

Mid Priority

- 213 Mill Road Site- two barn roofs and ground-mounted array closer to the house & parking area, which has the potential capacity of 42 kW on the big barn roof, 33 kW on the smaller barn roof and depending upon use needs of the parking lot and space adjacent to the garage behind the house, there is space to accommodate up to 100 kW of ground mounted or canopied arrays.
- Tribal housing site would be in the range of 330 kW for the combined 34 units. Depending upon the roof orientation, potential availability of unshaded, southerly exposure of the roof and potential parking canopy options, this site offers a solid opportunity to reduce fossil fuel use, reduce expenses for vulnerable residents and coupled with energy storage systems, an energy resilient housing option relying on renewable, indigenous resources.
- The leaching field at the wastewater treatment facility on Meetinghouse Road has the potential to accommodate up to 150 kW of capacity without tree trimming on the southerly border of the field. This is another area where multiple uses are planned and the potential capacity could be reduced and sited in canopy-mounted structures that would enable solar to coexist with other planned uses at the site.

Low Priority

- 213 Mill Road Site-Ground-mounted arrays that are feasible on the portion of the lot that abuts the Willowbend maintenance shed and service road. Ground-mounted arrays, sited to maximize the solar gain, would preclude the use of the land for anything other than grazing of sheep or chickens. This site can accommodate over 500 kW of capacity.

- Site behind the Tribal Community and Headquarters could potentially accommodate approximately 137 kW of ground-mounted or canopy mounted PV. Given the lease status with another entity, this site is on the low priority list.
- The roof of the wastewater treatment facility and the potential pole-mounted array adjacent to the road leading back to the leaching field are also on the low priority list given their small capacity.