

**Solar Power Feasibility
Bernardston Landfill
Bernardston, Massachusetts**

Prepared for:

Town of Bernardston Select Board & Town
Energy Committee

May 2019



JACOBS™

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1 Introduction

Jacobs Engineering has prepared this report to assist the Town of Bernardston in assessing the feasibility of a solar array installation at the Bernardston Landfill site. Specifically, this report outlines opportunities and constraints associated with siting a solar installation on a portion of property located at Nelson Drive. This report also includes ownership options, incentives, capacity sizing, and power sales opportunities. The site is owned by the Town of Bernardston and operated as the Bernardston and Leyden Transfer Station.

2 Site Conditions and Constraints

The subject site contains approximately 10 acres. The “solar project area” will be limited to the portion of the lot associated with the capped landfill activities and will not include the surrounding woodland or developed/graded areas fronting Interstate 91 on the west side of the lot. The portion of the parcel available for siting the solar installation project is approximately 8 acres.

The transfer station is sited on the northern portions of the property and includes of several small buildings as well as a graded area for dumpster staging and related loading activities. A paved access drive enters the property at the northwest of its frontage on Nelson Drive and continues west toward and around the buildings. The existing facility and access road will remain operational during and after the installation of a proposed solar facility.

The central portion of the landfill is moderately graded, with slopes which are considered suitable for ballast mounted solar panels typical of landfill installations. There are passive vents in place. They should have minimal impact on the solar arrays.



There is limited stormwater treatment and runoff control facilities at the site. A series of swales with check dams currently convey stormwater from the existing transfer station facility and landfill toward the southern portion of the landfill site. It should be noted that when the landfill was capped (2002) there was a retainage pond at the southerly end of the site. This retainage pond collected stormwater runoff from the impervious cap material. Soil was then placed over the impervious cap and a conservation mix of seeds applied. The landfill site is now covered with field grass.

An inspection of the landfill capping and maintenance measures did not identify evidence of erosion or flooding problems or concerns.

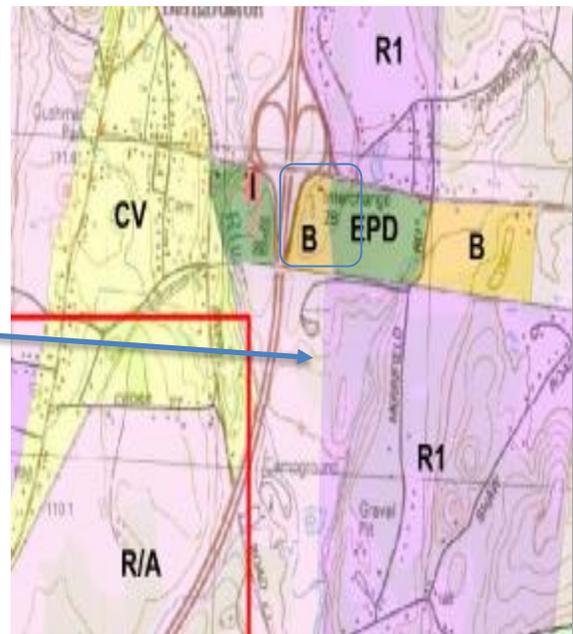
The Massachusetts Department of Environmental Protection does allow the installation of solar arrays on capped landfills. Local examples include the Northampton landfill solar project. Permits for the installation and operation of a solar project include:

Solid Waste Post-Closure Use Permit (MassDEP). A Major Post-Closure Use Permit (BWPSW36) is required if the planned renewable energy facility would involve construction of a structure or installation of equipment **on top of or into** the landfill's capping system.

Wetlands Notice of Intent (NOI) and ***Order of Conditions*** (Local Conservation Commission). At a minimum file a Request for Determination of Applicability to determine if the project will come under the Wetlands Protection Act. If so, a Wetlands NOI and Order of Conditions would be required if construction and/or operation of the proposed renewable energy installation will alter land within a wetland, marsh, swamp, riverfront area; is located on land subject to flooding; or is located within the buffer zone (100 feet) of a wetland. (See 310 CMR 10.00 and M.G.L. 131 Section 40).

Massachusetts Environmental Policy Act (MEPA) filing may be required if the project exceeds certain thresholds. For example, MEPA requires filing an Environmental Notification Form if a proposed renewable energy installation will generate 25 or more megawatts of electricity, or construction will require alteration of one or more acres of bordering vegetated wetland, ten or more acres of any other wetland area (including land altered to install roads and utilities), or disturbance of designated priority habitat for state listed endangered or threatened species.

Local zoning permits will also be required. Solar project impacting areas larger than 1 acre in Bernardston will need approval. The landfill site is located both in the R/A (Residential/Agriculture) and R1 (Residential) zones. See section 4 for more information.



3 Siting Considerations

The following conditions have been identified for the project:

- The solar racking shall be ballasted.
- No impact on the landfill cap integrity will be allowed.
- The entire array shall be fenced (7 foot-tall NESC compliant).
- The facility entrance drive may be utilized for the array access, but construction vehicles shall not restrict public use of the transfer station.
- Maintenance/mowing responsibility of the landfill cover slopes beyond the limits of the array are anticipated to transfer to the array developer/operator.
- A 20' wide "clear zone" is to be provided around all existing transfer station roads and facilities.
- A 15' gravel access road is to be provided around the outside perimeter of the arrays.

4 Zoning Bylaws

A review of the zoning bylaws and map was performed to determine permitting, dimensional and screening requirements. Based on the Town Zoning Map, the western portion of the property is zoned Residential/Agricultural while the eastern portion is zoned as Rural Residential.

Solar energy facilities greater than 5 acres requires Special Permit approval by the Zoning Board. Insert from Bernardston Zoning By-Laws (as Amended 10/25/2017):

3654. Size

A large-scale ground-mounted solar photovoltaic installation shall occupy a minimum size of one (1) acre and a maximum size of five (5) acres. No large-scale ground-mounted solar photovoltaic installation, as defined in this section, shall occupy more than five acres, in aggregate of all arrays, structures and buildings. All large-scale ground-mounted solar photovoltaic installations larger than five acres, including all accessory components, buildings, and structures, shall require a Special Permit, if such use is permitted within the Bernardston Zoning Bylaws. Refer to Section 2340 Dimensional Schedule.

5 Wetlands

The stormwater retainage pond that served the landfill during capping operation has silted in and is now mostly vegetated. In the winter it does fill to 2 feet of water depth. The solar project will not impact this former pond and a 50-foot buffer from the project shall be maintained.



The Massachusetts Wetland Protection Act defines the land within 200 feet of the perennial streams as Riverfront Area, which is considered protected resource area. There is a brook located east of the landfill that acts as a tributary to the Fall River. However, this brook is at least 400 feet away from any potential solar power equipment or construction impact. The local riverfront areas are not anticipated to impede the proposed project; however, any construction activities or disturbance within these resource areas will require filing of a Notice of Intent with Massachusetts DEP and the Bernardston Conservation Commission.

6 Natural Heritage and Endangered Species Program

A review of the Natural Heritage and Endangered Species Program (NHESP) was performed using MassGIS mapping. No areas of critical environmental concern, certified vernal pools, Priority Habitats of Rare Species, or Estimated Habitats of Rare Wildlife within the site area.

7 DEP Approval Process

The landfill was closed and capped under a permit from MassDEP (pursuant to 310 CMR 19; MassDEP Solid Waste Facility Regulations), and the transfer station facilities are regulated as a “post-closure use” of the landfill site. Any additional structures built or modified within the landfill footprint require a Permit Modification pursuant to 310 CMR 19.

MassDEP groups these into “Minor” and “Major” Modifications. In the case of solar siting, the distinction is whether the cap and/or solid waste are fully penetrated. “Major” modifications penetrate the cap and disturb entombed solid waste and require reconstruction of the entire cap to restore site conditions. “Minor” modifications, by contrast, either occur outside of the capped area, or solely within the cap thickness (the panel footings and infrastructure are entirely contained to the top two feet).

MassDEP has published an inventory of permits for landfill post-closure solar development (<http://www.mass.gov/eea/agencies/massdep/climate-energy/energy/landfills/landfills-with-post-closure-use-permits-for-renewables.html>). Since 2011, over 100 permits have been issued for similar solar array projects and only 14 of them were “Minor” permits. Therefore, major modifications are more typical for this type of development, and the project will most likely require a major modification.

It may be possible to build solar arrays with pad foundations, such as the ballasted systems proposed here, with the transmission lines buried in shallow soil. Note that a major modification could still be warranted due to other triggers (e.g., use of large/heavy equipment which could damage the cap).

Permit modifications must be approved in writing by MassDEP prior to construction. Engineering plans must be submitted to MassDEP, and there is no presumptive approval process for modifications on the landfill cap surface.

8 Massachusetts Environmental Policy Act

A Massachusetts Environmental Policy Act (MEPA) filing may be required for a solar photovoltaic installation on a closed and capped landfill if the project exceeds certain thresholds. A MEPA filing (Environmental Notification Form or ENF) is typically triggered if any of the following thresholds are exceeded:

- Construction of a new electric generating facility with a capacity of 25 megawatts (MW) or more, or expansion of an existing facility by more than 25 MW.
- Alteration of 5,000 or more square feet of bordering or isolated vegetated wetlands or alteration of one half or more acres of any other wetlands.
- Direct alteration of 25 or more acres of land for anything other than accepted agricultural or forestry practices.
- Creation of five or more acres of impervious area.
- Alteration or disturbance of Priority Habitat or Estimated Habitat for one or more state-listed rare species of animals or plants.
- Location within a state-designated Area of Critical Environmental Concern (ACEC).

The proposed solar installation on the closed Bernardston Landfill is not anticipated to exceed any of these thresholds. Therefore, a MEPA filing is not anticipated to be required at this time.

9 Soils

The approved landfill cap includes twelve (12) inch minimum of impervious soil with a permeability of 1.0×10^{-7} cm/sec or less and a top layer of loam at least six (6) inches thick to support vegetation. Confirmation excavations and/or soil testing has not been performed as part of these investigations, but it has been assumed that the cap conforms to this standard throughout the landfill and that the as-built conditions will be an acceptable base for ballast mounted array tables. Both the top soil quantity and the cap integrity will need to be verified during the project development phase.

10 Stormwater Management

Since the Project will disturb more than one (1) acre of land, a Notice of Intent is required to be submitted to the Environmental Protection Agency (EPA) for coverage under the National Pollution Discharge Elimination System (NPDES) Construction General Permit.

The project will be required to be designed to comply with and exceed the requirements of the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. The final design shall comply with the requirements of the Massachusetts Stormwater Handbook. A Stormwater Permit Major Project Application will also be required in compliance with the Bernardston Stormwater Regulations and Stormwater Management Bylaw.

Although the solar panels are impervious, the surface condition beneath them will be largely unchanged, and stormwater will continue to travel by sheet flow and shallow concentrated flow on a pervious grass or meadow surface. Based on these conditions, water quality treatment and detention/infiltration are not anticipated to be required for the array features.

Construction of a gravel access road around the interior of the solar facility is anticipated to modestly impact the hydrologic conditions of the site. Based on the limitations associated with the landfill and on the intent to maintain the project within altered areas, supplementation of the existing swale network should not be required.

11 Electrical Interconnect

The site is in the Eversource (WMECO) service area. There is a three-phase medium voltage feeder serving the site (assumed to be 13.2kV or 13.8kV) originating at Route 10 (Northfield Road).

The feeder is pole mounted along the side of the access drive terminating at a pole mounted transformer which feeds the transfer station building at 480-volt, three-phase.

The proposed interconnect point would be at or close to the final pole, identified as WMECO Pole No. 59/6 and located by the transfer facility on Nelson Drive.

Based upon site availability and constraints we estimate that by utilizing 400 Watt solar modules (SunPower SPR-MAX3-400 or Equivalent) an approximate system capacity of 2,000 kW and 2,660 kW (dc).

For solar projects that are connected into the electric grid an ***Interconnection Agreement*** is required. The process to acquire the agreement starts with a Pre-Application Submittal. The pre-application gives the utility an opportunity to do a quick review and notify to solar project if there are any circuit constraints. A Pre-application submittal form for the solar project can be found at Attachment A.

When ready to move forward, the *expedited* Interconnection Application can then be submitted (see Attachment B). The cost for the Interconnection Application is \$4.50/kilowatt (project size). For the Bernardston Landfill Solar project at 2,660 kW solar project this totals \$ 12,000. The *standard* Interconnection Application has no fee, but the turn- around time for review and approval can be up to 180 days.

In addition, a *One-line* Electrical Drawing is required with the Interconnection application. An example one-line with solar power and energy storage is shown below.

and projects in the queue are accepted at a *lower rate*. When “Block 2” is filled with committed projects, then “Block 3” is opened at a lower rate. The “Guideline on Capacity Blocks, Base Compensation Rates, and Compensation Rate Adders” was released on January 11, 2018 and is found in Attachment C.

Currently the Eversource *West* (formally WMECO territory) SMART blocks are oversubscribed. However, the Eversource *East* blocks are significantly undersubscribed and there are efforts to re-apportion some of the East’s capacity to the Eversource West.

Assuming the Bernardston 2,660-kilowatt(dc) solar project applies for the SMART program but is only accepted into a re-apportioned Block 8. The 20-year fixed rate incentive for solar generated power is based at:

Base compensation	\$0.10757/kWh
Public Entity Project	\$0.01500/kWh
Qualified landfill re-use	<u>\$0.03006/kWh</u>
Incentive total value	\$0.15263/kWh

If the project generates 3,468,000 kWh/year, then the incentive should be \$529,000 per year. *This is in addition to the value of the electricity.*

The SMART program also has incentives for Energy Storage Systems that are adders to the kWh incentive value. There is no set price and it will need to be negotiated.

13 Energy Storage System Option

Energy Storage Systems (ESS) are utilized more frequently in support of renewable power systems. The ESS consists of a master controller to direct energy flows, batteries and a bi-directional inverter for converting solar generated or battery stored DC power to AC for use or feed onto the grid or from AC to DC for storage (batteries can only store DC power). The size of the ESS is usually described by both its instantaneous discharge capacity in kW or MW, and its total energy storage in kWh or MWh.

An example of a local solar and energy storage project is at the Town of Sterling in Central Massachusetts. The Sterling Municipal Light Department (SMLD) owns the system and uses it to provide emergency backup power to the town’s critical facilities providing police, fire and EMS services in the event of a grid outage and provides electricity cost savings to ratepayers.

Sterling Municipal Light Department has installed a 2 MW/3.9 MWh battery storage system at Sterling’s Chocksett Road Substation that is able to isolate from the main grid in the event of a power outage and, with an existing PV array, provide up emergency backup power to the

Sterling police station, dispatch center and a community facility providing first responder services.

By discharging the batteries down to as low as 50% during hours of peak electricity demand and feeding the grid, the Sterling energy storage project is expected to generate revenue (savings) while still retaining enough stored energy for up to 12 days of emergency back-up power.

This \$2.7 million project has a simple payback of less than seven years.

If the Town of Bernardston looks to relocate its emergency services or a community center near to the Landfill Solar project (at the landfill site or on Northfield Road or Merrifield Road) then there would be an opportunity for using ESS as both a renewable and resilient back up power source. There is also the ability to secure SMART program incentives (negotiated with Mass DOER) to help with positive revenue flow.



14 Federal Financial Incentives for solar power and ESS project

Investment Tax Credit (ITC)

Qualified solar PV projects are eligible for a federal investment tax credit of up to 30% of eligible system costs, if installed by December 31, 2019. The tax credit can be taken and applied against the federal tax obligation of a for-profit entity. If installed by the end of 2020: Owners of new solar can deduct 26 % of the cost of the system from their taxes. If installed by the end of 2021: Owners of new solar can deduct 22% of the cost of the system from their taxes. From 2022 onwards: owners of new commercial solar energy systems can deduct 10 % of the cost of the system from their taxes.

Accelerated Depreciation / Bonus Depreciation

Under the federal Modified Accelerated Cost Recovery System (MACRS), businesses can recover investments in eligible property through an aggressive depreciation schedule (5 years).

15 Ownership and Operation Options

Option A: Town of Bernardston as Developer, Owner and Operator

In this approach, the municipality serves as the developer, financier, builder, and owner of the PV system. As owner, the municipality enjoys all of the direct benefits resulting from the project, including electricity savings and revenues from SMART incentives. Subcontractors are generally used for most of the the development tasks but need to be managed by municipal officials or volunteers.

The structure of a municipally developed and owned project typically follows one of two paths:

The municipality issues a single request for proposals (RFP) or request for qualifications (RFQ) for a firm that can engineer, design, build, and manage all aspects of system implementation.

Or a separate design firm is hired to provide some of the major tasks included in developing the project including the solar upfront project analysis, a conceptual design, securing permits and producing an RFP to hire an Engineering, Procurement, and Construction (EPC) firm that will manage the balance of design, purchase of materials, installation and commissioning.

This approach gives the Municipality the most control over the entire project and its operation but reduces the ability to use *Federal Incentives* based on tax credits and depreciation.

Option B: Land Lease

The land lease scenario is significantly different from the municipal ownership scenario, in that much of the risk and responsibility is shifted away from the municipality to the project developer/owner. In a land lease scenario, the municipality selects a vendor to design, finance, build, own, operate and maintain a system at a municipally owned site. The vendor is responsible for all aspects of project development, assumes all risks, and claims much of the project revenue. In exchange, the project developer/owner negotiates a land lease with the host municipality.

The value of the land lease may vary by developer and project site, so municipalities should expect this to be an important point of negotiation in the vendor RFP/selection phase. In some cases, a power purchase agreement may also be negotiated with the host municipality, separate from the lease payment, or the lease payment may be included as part of the PPA. If included as part of the PPA, then the negotiation over the price for electricity should contemplate the inclusion of that payment. The Town of Northampton used this method and receive both a land lease price and a *Payment In Lieu of Taxes* (PILOT).

Option C: Power Purchase Agreement and Credit Purchase Agreement

Power purchase agreements, or PPAs, are contract instruments used in energy project development, and valid PPAs are critical to project financing by a developer. In this case, the solar PPA is a contract between a project owner and project host through which the project host, the municipality, buys the electricity generated by the PV array from the owner at a predetermined rate. From the perspective of the municipality, traditional PPAs provide a known and predictable price of power, with the goal of long-term savings. From the standpoint of the project owner, the PPA provides a fixed revenue stream to finance project development, installation, and operation. PPAs in Massachusetts can be used in both investor- owned utility and may be used in some municipal light territories.

The precise terms of a PPA are subject to negotiation. As an electricity end user, the municipality signs an agreement with the project developer to pay a specific rate for every kWh produced by the system. PPAs may incorporate a fixed price a fixed price with an agreed upon escalator, or a price that is indexed to the actual retail cost of electricity (from the utility) for a fixed number of years. Key variables impacting the PPA include the site's potential for energy production and the credit- worthiness of the off-taker.

The second type of structure, the net-metering Credit Purchase Agreement (CPA), is like a PPA. CPA transactions are enabled by the Massachusetts "Green Communities Act of 2008". Solar energy systems located in investor owned utility territories can transfer the value of their energy production (on a per kWh basis, as determined by the utility rate) to certain other customers via net-metering credits. These CPA transactions can take a number of different forms. In some cases, they may resemble more conventional PPA structures (e.g., fixed price/fixed period), but

they may also incorporate strategies such as a fixed discount for a fixed period of time.

From the standpoint of the municipality, there can be significant advantages to pursuing a Credit Purchase Agreement, including reduced public procurement burden, reduced risk (fixed discount with no downside risk), and higher flexibility.

Performance Based Revenue Via Power Purchase/Net Metering Credit Purchase Agreements
Solar PV revenue models based on PPAs or CPAs share a similar risk and benefit profile as the land lease structure outlined previously. However, a fixed lease payment provides no risk to the host municipality: the payment is made from the project owner to the host municipality whether the system operates or not. By contrast, revenue-based payment may fluctuate if the system produces more or less power in a given year. A revenue-based structure (PPA or CPA) provides additional financial incentive to the developer to maximize system production, which helps to increase savings for the host customer.

Option D: Hybrid Land Lease and CPA/PPA Revenue Structure

A municipality may choose to negotiate a hybrid land lease and PPA/ CPA structure. This type of project provides both guaranteed, low-risk revenue by way of a long-term land lease, and a performance based revenue stream that provides a hedge against long-term electricity prices. This arrangement encourages the developer to design the system for long-term operation and adds value in the event of a system ownership change to the host municipality.

16 Cost Estimates

For a 2,600 kW (dc) system:

Development Costs

Permitting	\$ 25,000
Interconnection Application Development & Fees	\$ 22,000
System design	\$ 20,000
RFP for EPC firm	\$ 15,000
Owners Project Manager	<u>\$ 75,000</u>
	\$ 157,000

Capital Costs

Ballasted Foundations	\$ 225,000
Mounting Racks	\$ 450,000

Solar Panels	\$1,280,000
Balance of Plant (Inverters, controls, etc.)	\$ 850,000
Overhead and Markup	<u>\$ 550,000</u>
	\$3,512,000

A 2,660 kW(dc) solar project should be able to produce 3,468,000 kWh/year.

If net metering is used, no incentives utilized (municipal owned), and the electric value is at \$0.15/kWh then the simple payback is about 7 years.

If net metering is used, no incentives utilized (municipal owned), the project is approved for the SMART incentive program and the electric value is at \$0.15/kWh then the simple payback is less than 4 years.

For a simple land lease and PILOT compensation the Town should realize between \$40,000 and \$100,000 per year.

17 Summary of Findings

Jacobs Engineering has performed an initial investigation regarding the feasibility for constructing a photovoltaic energy system (PV array) at the Bernardston Landfill. The following is a summary of the most significant findings of these investigations:

The solar array facility is proposed within the existing 8-acre capped landfill. Based on the constraints identified, it is anticipated that an array system comprised of approximately 1,500 kW (dc) can be sited on the property.

A Concept Site Plan is attached as Attachment D.

The proposed project is anticipated to require the following state, local and utility permits:

- Permit Modification pursuant to 310 CMR 19 (MassDEP Solid Waste Facility Regulations).
- Special Permit to be reviewed by Zoning Board of Appeals
- Notice of Intent (WPA Form 3) to MassDEP Bureau of Resource Protection-Wetlands
- Notice of Intent to Bernardston Conservation Commission
- Electrical Permit (Franklin Regional Council of Governments)
- Interconnection Agreement (Eversource)

Leasing the landfill site to a developer is the lowest risk and lowest return option but is viable and of economic benefit to the town.

There are active Federal Incentive programs that can reduce the final cost of the solar project by as much as 40% (ITC and MACRS). However, only private firms with “tax appetite” can utilize these incentives. If the Town decides to bring in a developer for a PPA or CPA, the benefits of these incentives should partly flow down to the Town and the developer should be able to offer (net metered) power at a reduced price.

There are no active grant programs, or SMART capacity blocks currently available, however DOER is actively promoting community solar PV and Energy Storage System support programs and grant funding may be available in the future.

Attachment A:
Pre-Application Submittal Form for Eversource

Attachment B:
Interconnection Application Submittal Form for
Eversource

Attachment C:
SMART Program Block Incentives

Attachment D:
Concept Plan @ 1,200 kW dc Capacity

