Greens Corners Solar LLC

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(Revision 2, January 2022)

Decommissioning and Restoration Plan

DECOMMISSIONING AND RESTORATION PLAN

Boralex - Greens Corners Solar Project



January 13, 2022
(Rev. 2)

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1. Introduction

Boralex (the Applicant) has commissioned this Decommissioning & Restoration Plan (the Plan) to outline the means and methods to decommission the Greens Corners Solar Project (the Project) in the event that the Project cannot be completed or at the end of the Project's useful life. This Plan intends to outline the steps which will be followed by the Applicant to remove the system, dispose of or recycle its components, and restore the land to its pre-construction condition. In addition, the Plan intends to provide an opinion of probable costs of decommissioning and restoration based on the preparer's experience of similar facilities. This Plan has been prepared in accordance with the guidance provided by New York State Energy Research and Development Authority (NYSERDA) for *Decommissioning Solar Panel Systems* in its "New York Solar Guidebook for Local Governments"[1].

The following items are addressed in this Plan:

- The party responsible for decommissioning;
- Defined conditions upon which decommissioning will be initiated (e.g., end of land lease, no operation for 12 months, prior written notice to facility owner, etc.);
- Procedure for removal of all nonutility owned equipment, conduit, structures, fencing, roads, and foundations;
- Procedure for restoration of property to condition prior to solar development;
- The timeframe for completion of decommissioning activities;
- Plans for updating the decommissioning plan; and,
- Opinion of probable costs (cost estimate table).

The goal of decommissioning is the safe and efficient removal of all solar energy facility components, and reclamation of the site to conditions as close to pre-construction characteristics as possible including restoration of native vegetation, habitat, and/or land use. Drainage facilities constructed as part of the Project will typically remain in place in order to maintain the capture and recharge of surface runoff on the site. The same safety protocols that are used during construction will be used during decommissioning.

[1] "New York Solar Guidebook for Local Governments." Decommissioning Solar Panel Systems, New York State Energy Research and Development Authority (NYSERDA), Aug. 2020, www.nyserda.ny.gov/All%20Programs/Programs/Clean%20Energy%20Siting/Solar%20Guidebook.

2. Project Background

The proposed Project is intended to generate 120 megawatts of solar powered renewable energy generation capacity. The Project will be sited on approximately 3,031 acres located primarily west of Interstate 81 and southwest of the City of Watertown in the Town of Watertown and Town of Hounsfield in Jefferson County, New York. The Project will consist of rows of photovoltaic ("PV") modules no more than 15 feet above grade arranged in discrete subarrays dispersed throughout the site, as well as associated electrical collection lines, inverters, fencing, gravel or aggregate access roads, and temporary laydown areas. An on-site substation will combine the facility electrical output voltage and increase it to the transmission line voltage of 115 kilovolt (kV) via step-up transformers that connect to an existing on-site utility transmission line.

The Applicant intends to construct, own, and operate the proposed Project. As owner-operator, the Applicant intends to build a long-term relationship with the Towns, landowners, and project stakeholders. The Project construction, operation, and decommissioning will be committed to the health, safety, and welfare of the Project stakeholders. At the time of issuance of this Plan, a point of contact for the Project is listed below.

- **Applicant Name**: Boralex, Inc.
- **Contact**: Andrew Buckley, Greenfield Development Manager
- **Address**: 39 Hudson Falls Road, South Glens Falls, NY 12803
- **Telephone**: 518-538-8152
- **E-mail**: andrew.buckley@boralex.com

It is possible and likely that the Project contact person may differ from development, into construction, and through long-term operation. The Applicant will update this plan to revise the Project contact person if it should change during the evolution of the Project's life. The updated plan will be provided to project stakeholders, including the Town of Watertown and Town of Hounsfield upon update.

3. Conditions for Decommissioning

The Plan will be implemented in the event of the following: the facility cannot be completed, for whatever reason; the end of useful life of the facility; or abandonment of the facility.

Typically, photovoltaic (PV) modules (modules) have a useful operational life of approximately 30 to 40 years. The Applicant intends to construct the solar arrays (consisting of multiple modules) on privately owned lands controlled by lease agreements or purchased by the Applicant. Based on these terms, it is anticipated that the Project will have at least 35 years of operational life for solar energy production. While it is possible that the use of this site for solar energy production may be extended, or additions may be completed at a future date, at this time the Plan has been developed for the Project with an expectation of a useful life of 35 years.

Likewise, implementation of this Plan under an abandonment condition may occur if the solar arrays are inactive for a certain period. Abandonment requires that solar panel systems be removed after a specified period if they are no longer in use, or if the construction is halted and the Project remains non-operational due to unforeseen reasons. For example, decommissioning due to abandonment would commence if the Project has not generated electricity for a period of 12 continuous months, unless the 12-month period of no energy output is the result of a repair, restoration, or improvement to an integral part of the Project that affects the generation of electricity and that repair, restoration or improvement is being diligently pursued by the Applicant, or a "force majeure" event. Such an event may be related to conditions outside the reasonable control of the Applicant (e.g., floods, earthquakes, hurricanes, inclement weather, sabotage; etc.). The Applicant will work with the Towns and stakeholders in the event of a potential abandonment condition.

Decommissioning of the Project will include the disconnection of the facility from the electrical grid, then the removal of all facility components. These components generally include:

- Photovoltaic (PV) modules, associated racking, pile supports, and above-ground cables;
- Inverter units, unit substations, transformers, and other related electrical components;
- Perimeter fencing and posts,
- Concrete foundations;
- Underground collection lines shallower than 48 inches below grade; and,
- Gravel/aggregate access roads.

Some Project components, such as access roads, may be left in-place and intact based on the property owner's option. In these situations, items to remain will be addressed through individual lease agreements with landowners prior to the start of decommissioning. In addition, underground collection lines will be abandoned in place per New York State Department of Agriculture and Markets (NYSDAM) Guidelines for Agricultural Mitigation for Solar Energy Projects[2] (the NYSDAM Guidelines).

[2] *Guidelines for Solar Energy Projects - Construction Mitigation for Agricultural Lands*, NYSDAM, 18 Oct. 2019, agriculture.ny.gov/system/files/documents/2019/10/solar_energy_guidelines.pdf.

4. Decommissioning Notification and Schedule

Decommissioning shall begin immediately after the facility has ended its planned useful life, or, abandoned due to a period of twelve months or longer of cessation of operation as a solar energy facility collecting and storing energy, and transferring and distributing it to the electrical grid. Periods during which the facility is not operational for maintenance, repair, or due to catastrophic events beyond the Applicant's control, during which the Applicant works diligently to return the facility to full operating status, shall not trigger the decommissioning requirement herein.

The Applicant will provide written notice to the Towns and adjacent property holders no less than 30 days prior to commencement of decommissioning activity. The notice is expected to include a preliminary timeline of decommissioning activities prior to the start of decommissioning and restoration activities. It is anticipated that the Applicant, or its agent, will obtain any necessary federal, state, or local permits required to complete the decommissioning and site restoration activities described herein.

Removal of the equipment will take approximately 3 to 5 months, and completion of the reclamation will take an additional 2 to 3 months. This timeline may be extended if there is a delay beyond the control of Applicant including, but not limited to, inclement weather conditions, planting requirements, equipment failure, or the availability of equipment or personnel to support decommissioning. This timeline will also be dependent upon appropriate seasons for final site restoration, as per the NYSDAM Guidelines. It is anticipated that decommissioning planning (notification to Towns/stakeholders, securing permits and approvals) would begin in late winter to early spring, to allow demolition and restoration to take place during summer and fall months.

5. Decommissioning Activities

At the end of its useful economic life, the Project will be decommissioned, and solar modules, collection substation, and associated aboveground infrastructure will be removed. Removal of equipment will be completed in accordance with manufacturers' or vendors' recommendations, as well as applicable federal, state, and local regulations.

Prior to decommissioning, the facility will be disconnected from the utility power grid. Temporary soil erosion and sedimentation control measures will be re-implemented during the decommissioning period and until the site is stabilized. Then, Project components will be dismantled and removed using conventional construction equipment. Material will be recycled, disposed of, or resold safely. Removal of each Project component is described below:

5.1 PV Modules, Racking, and Posts

- Individual PV modules will be disconnected from the on-site electrical system.
- Individual PV modules will be unbolted and removed from the support frames and carefully packaged for collection and return to a designated recycling facility for recycling and material re-use. If there is no possibility for re-use of these components, the modules will be transported to an approved recycling facility where the individual components (metal, glass, semi-conductor material) can be separated and individually recycled.
- PV panel support steel (racking) will be disassembled and removed. This will be accomplished by stabilizing the frame, and cutting the support posts (legs) at the connection point of the frame at least one to two feet above the ground surface. This will allow the remaining support post, which is embedded below-grade, to be pulled from the ground using a post-puller or excavator. Crossbeams and purlins will be cut to an appropriate size to allow handling and transport via dump truck to a staging location where the racking steel can be aggregated, bundled, and transported off-site. Since the racking support structure and frame are conventional metal construction, it is expected that the material may be salvaged for resale off-site by an approved vendor.
- Foundation support posts will be removed using a post-puller, excavator, or similar equipment. For posts which are unable to be pulled due to embedment into rock, these posts may be cut near within 6 inches of top of rock and abandoned in-place. After being removed, posts will be stockpiled and staged in a common location where it can be bundled, transported, and salvaged for resale off-site by an approved vendor.

5.2 Electrical Components and Cabling

- Electrical interconnection, transmission, and distribution cables will be pulled from conduit and recycled offsite by an approved recycling facility. Conduit will be abandoned in place if deeper than 48 inches or excavated/removed if buried shallower than 48 inches.

- The method of removal is expected to be excavation to expose the cable on one end of the trench, then use of tractor or backhoe to pull out the cables in the common trench.
- Conduit risers will be removed and any abandoned conduit will be sealed or capped. All excavations from removed AC cables, DC cables, conduits and risers will be backfilled with native material.
- Electrical and electronic devices, including inverters, transformers, modules, support structures, lighting fixtures, and their protective shelters will be recycled off-site by an approved recycler.
- Metal components of inverters, such as fans and fixtures, will be disposed and/or recycled. The remaining components will be disposed of in accordance with the manufacturer's requirements and standard practices at the time of decommissioning.
- Any chemicals, fuels, oils, transformer oils, and other potential hazards chemicals and wastes will be removed from the site. These will be disposed of in accordance with state and federal laws. Any areas of known chemical spills will be identified, excavated and contaminated soils will be removed. Chemicals and hazardous materials will not be stored on-site, but rather at an off-site operations and maintenance building. In the event of a spill or release at the site, all contaminated material will be removed and disposed of immediately. However, it is anticipated that hazardous materials will not be present in significant quantities and the risk of spill or release is extremely low.

5.3 Fencing, Concrete Pads, and Accessory Site Features

- Fencing may be removed or left in place based upon the landowner's anticipated reuse after decommissioning. If removed, fencing will be cut to allow for transportation and will be recycled off-site at an appropriate facility. Likewise, fence posts will be pulled to remove the element from the site.
- Concrete pads and foundations will be removed by an excavator, jack hammer, or similar equipment and tools. Concrete, once removed, will be removed and broken into smaller pieces and sizes which can be transported to an off-site reclamation location or disposal facility.
- Gravel and aggregate stone from access roadways are expected to be removed using a skid steer, excavator, or similar equipment. It is possible that the Town(s) or landowner(s) may accept the aggregate for the purposes of re-use on local roads or other reclaimed purposes. However, for this Plan, once removed it is expected that gravel will be removed, stockpiled on-site in accordance with soil erosion and sediment control best practices, then hauled off-site to a reclamation center. It is expected that the gravel will be of sufficient quality that it may be re-used, with minimal processing, as construction fill.
- Permanent drainage facilities such as culverts, drainage infrastructure, and rip-rap will remain in place to maintain the capture and recharge of surface runoff on the site.

- Excess soil generated by decommissioning activities (such as pulling posts, removal of aggregate for roadways, or excavation for removal of foundations) will be used on-site to backfill excavations, trenches, and holes generated by removal activities. It is not expected that excess soil for off-site disposal will be generated; however, should excess soil be generated, it will be stockpiled on-site in accordance with soil erosion and sediment control best practices prior to being hauled off-site to an approved end location.
- Where foundations are removed and excavations are backfilled with clean, compatible soil, the soil will be compacted to a density similar to the surrounding areas.
- Geotextile separation fabric, which may be generated from the removal of access roads or foundations, is expected to be inter-mixed into aggregate upon removal. As common practice, this co-mingled material will be separated at the aggregate reprocessing site.
- Any remaining debris generated from the decommissioning activities will be separated and stockpiled into items to be landfilled, and to be recycled. Once separated, the material(s) will be transported from the site to the appropriate end location.

Road traffic is expected to increase during the decommissioning and restoration activities, since worker vehicles and equipment will be necessary to complete the removal work. There is potential for dust and noise generation in the areas where decommissioning and restoration activities are taking place; however, it is expected that the Applicant will follow local work-hour restrictions, noise ordinances, and soil erosion and sediment control measures during their work.

6. Stormwater Management and Erosion Control Measures

Decommissioning and restoration activities will require the use of machinery, techniques, and procedures similar to those during the construction-phase of the Project. Therefore, it is expected that these site activities will follow similar erosion control and stormwater management measures and best management practices as outlined in the Project's Stormwater Pollution Prevention Plan (SWPPP). These controls will also be in accordance with the New York State Standards and Specifications for Erosion and Sediment Control (the Blue Book)[3]. The selection, design, and implementation of erosion and sediment control measures will need to account for site topography, climate and seasonality during the completion of work, native on-site soils and their erodibility, and the type of existing and proposed vegetative cover established.

At a minimum, it is expected that silt fencing, stabilized construction access points, and adequate soil stockpile areas will be installed prior to the start of decommissioning and site restoration activities. During decommissioning and restoration activities, minor grading and excavation may be required which will necessitate the use of erosion control features such as temporary berms, swales, and stockpiles to prevent and manage erosion. Commonly used best management practices which may be employed during decommissioning and site restoration activities include:

- Protect natural features at the site, such as established vegetative growth, topsoil, topography and grades, and drainage features such as natural streams and watercourses;
- Protection of slopes and exposed soil, using proper planning to minimize amount of area opened and exposed at any given time, as well as erosion control fabrics;
- Stabilize soils as quickly as possible following disturbance of work areas;
- Protect culverts, inlets, and drainage structures from being silted;
- Establishing perimeter controls around areas to be restored; and,
- Retain sediment on-site using silt fences, coir logs, or swales to prevent transport off-site during stormwater conditions.

At the completion of restoration activities, any silt fences, barriers, or temporary features will be removed.

[3] Lake Jr., Donald W. New York State Standards and Specifications for Erosion and Sediment Control. New York State Department of Environmental Conservation, 0AD., https://www.dec.ny.gov/chemical/29066.html

7. Site Restoration and Environmental Management

It is expected that well-planned and well-managed renewable energy facilities, such as this Project, are not expected to pose environmental concerns at the time of decommissioning and restoration. Decommissioning of the Project will follow the standards and best practices at the time of decommissioning. This Plan will be updated as necessary to incorporate changes in best practice, technologies, and site restoration methods as the Project evolves along its life.

Per the NYSDAM Guidelines, no Project restoration activities will occur in agricultural fields between the months of October through May (late fall into early spring) unless favorable soil moisture conditions exist. Subgrade de-compaction and topsoil replacement will also be avoided after October 1st until the following spring. If restoration activities are required to extend beyond October 1st, provisions will be made to restore and/or re-seed poorly germinated and eroded areas in the following spring to establish proper growth.

Notwithstanding, decommissioning activities such as the removal of Project components and limited excavation to remove below-grade foundations and cables could result in environmental impacts similar to those during the construction phase of the Project. For example, the potential for soil disturbance during decommissioning and restoration activities could create erosion potential, or machinery used during site activities could have potential for fuel spills. It is anticipated that spill prevention, soil erosion, and stormwater pollution and prevention best practices will be employed. These protective measures are expected to remain in place until the site is restored, and ground cover is stabilized.

7.1 Restoration in Array Areas

Once decommissioning activities are completed, site restoration activities will commence. During this phase of work, ground disturbance will be minimized to the extent practical to allow the site to be restored to original land use. Soils stockpiled and generated during decommissioning activities will be re-used across the site during restoration activities, following the NYSDAM Guidelines, and spot restoration and re-seeding will be completed in areas where disturbance has deteriorated or damaged the established vegetative cover.

Except minor trenching and grading during construction, it is anticipated that areas occupied by solar arrays, both underneath panels and rows between panels, will remain either in their undisturbed natural state as grasses and indigenous plants, or host agricultural co-use activities as described in Exhibit 15, prior to, during, and after construction. Since array areas will have established vegetation, at this time, the Applicant does not intend to plant crops, trees, or other vegetative planting. However, a temporary seed mix may be used in agricultural areas. The exact seed mix and planting requirements will be discussed with each individual landowner in their lease agreements. Per the NYSDAM Guidelines, in areas where topsoil is stripped, soil de-compaction must occur prior to replacement of topsoil.

7.2 Restoration for Roadways

Restoration will also occur where pervious gravel access roads were previously established for the site. Unless a landowner has specifically requested an access road remain in-place, it is expected that the stone and soil subbase beneath the road will be excavated and removed. Afterward, the soil subgrade below the aggregate will be de-compacted using a conventional excavator with bucket attachment, tiller, or harrowing discs. Where these access roads are de-established, the ground surface will be lightly re-graded to blend and match the surrounding elevations and contours. Areas will not be graded any steeper than a 3H:1V slope. Culverts and drainage infrastructure adjacent to roadways will also be removed, and streams, drainage channels, or other man-made features constructed to promote drainage will be removed and restored to pre-construction conditions. The removal of these drainage features will be completed in accordance with the New York State Standards and Specifications for Erosion and Sediment Control (the Blue Book).

After removal of gravel for access roads, per the NYSDAM Guidelines, these areas disturbed and compacted by construction must be de-compacted to a depth of 18 inches with a deep ripper, heavy-duty chisel plow, or similar attachment. Then, the near-surface soil will be lightly re-compacted only to minimize the potential for erosion and run-off, as well as placement of topsoil and seed to allow growth. The topsoil used to restore the road surfaces will either be returned from recorded project excess native topsoil disposal areas, if present, or imported topsoil free of invasive species that is consistent with the quality of topsoil on the affected site. Since the perimeter access roads were proposed to follow the edges of properties and parcel lines during the site design, it is expected that these areas on the perimeter of land parcels will have limited impact to future agricultural uses.

7.3 Restoration of Cable Areas

Following the NYSDAM Guidelines, all buried and embedded cables shallower than 48 inches of grade will be removed.

7.4 Restoration of Vegetative Cover and Potential Future Uses

All disturbed areas during decommissioning activities will be restored to pre-construction conditions during the restoration phase of work. It is anticipated that stabilization measures such as silt fences, bioswales, erosion control fabrics and blankets, and other methods of erosion control and vegetation protection will be used to promote the establishment and growth of vegetative cover across disturbed Project areas.

Based on historic land use of the Project area, it is anticipated the Project area may be used for agricultural purposes after the completion of the decommissioning activities. Agricultural activities may be occurring during the Project's operational life, as described in Exhibit 15, and therefore it is reasonable to presume those activities will continue, and the decommissioning

activities are to be carried through following the NYSDAM Guidelines which would promote the viability of agriculture as a future land use for the Project area.

If an area disturbed by the Project is not planned to be used for future agricultural purposes, this area will be re-seeded using a native seed mix. The Applicant will use native seed or grasses free of noxious weeds or other vegetative growth to prevent the introduction of invasive and undesirable plant species into reclaimed areas. This use of a native seed mix will promote the natural succession and return of the Project to original site conditions. If mulch is required to be used, the mulch will be certified as "weed-free" prior to the use in restoration activities. The Applicant will consult with NYSDAM and NYSDEC prior to site decommissioning and restoration activities to review the proposed seed mixture(s) prior to use.

8. Decommissioning Funding: Gross Decommissioning Costs

The gross decommissioning cost excludes any projected salvage value. The estimated opinion of probable gross decommissioning costs for the Project with contingency is approximately $7,224,475 in 2021 dollars. A detailed breakdown of this opinion providing justification for these estimates is provided in Table 1 below.

Table 1 – Gross Decommissioning, Restoration, and Contingency Cost Estimate for Project

Item/Task	Quantity	Unit	Unit Price	Total Price
Planning and Site Tasks				
Contract Procurement, Contractor Selection, Award	1	LS	$20,000	$20,000
Mobilization	1	LS	$75,000	$75,000
Office trailer	5	Month	$1,200	$6,000
Site facilities (portable toilet, electronics)	1	LS	$15,000	$15,000
Superintendent	5	Month	$10,500	$52,500
Environmental Monitor (Per NYSDAM Req.)	5	Month	$5,250	$26,250
Site Preparation				
SWPPP and Erosion Control Measures	1	LS	$40,000	$40,000
Stabilized construction entrance	1	LS	$7,500	$7,500
Establish soil and material stockpile areas	1	LS	$5,000	$5,000
Environmental due diligence sampling	1	LS	$10,000	$10,000
Dust control and site monitoring	1	LS	$5,000	$5,000
Disassembly, Removal, Disposal				
Removal of PV Modules	512,190	Each	$2.50	$1,280,475
Removal of Inverters, Concrete Pads, and Cabling	44	Each	$18,550	$816,200
Removal of Racking, frame, support assemblies	8,550	Each	$78	$666,900
Removal of Foundation Posts	20,500	Each	$95	$1,947,500
Removal of Fencing	123,700	LF	$1.75	$216,475
Removal of Access Road (gravel, fabric, subbase)	41,200	LF	$12	$494,400
Removal of substation equipment	1	LS	$89,000	$89,000
Removal of substation concrete pads	1	LS	$65,000	$65,000
Removal of substation cabling and connectors	1	LS	$76,000	$76,000
Site Restoration				
Re-seeding (10% of project area)	266	Acres	$920	$244,352
Re-grading and restoration of access roads	41,200	LF	$3	$123,600
Gross Decommissioning Costs				**$6,282,152**
Contingency				
Contingency			15%	$942,323
Gross Decommissioning Costs + Contingency				**$7,224,475**

Note: "LS" = Lump Sum, "LF" = Linear Foot

The following assumptions were made to estimate the cost of decommissioning the Project:

1. The opinion of probable costs assumes that an experienced, third-party contractor retained by the Applicant will complete the decommissioning and restoration activities. It is expected that this contractor is experienced in the construction and decommissioning of solar facilities of similar size and scale.
2. The estimate is based on and presented as current-day costs (2021-year).
3. The opinion is based on the 2020 RSMeans Heavy Construction and Site Work & Landscaping Cost estimating manuals, as well as the experience of the preparing engineer.
4. It is expected that, after 35 years, the site will be mature with vegetative cover and or agricultural crops. The re-seeding budget has been provided to accommodate re-seeding of localized areas, as needed.
5. Removal of Inverters, Concrete Pads, and Cabling expected when shallower than 48-inches below grade.
6. Costs include limited foundation removal to 36 to 48 inches below grade, and assumes concrete is adequate for fill or recycling.
7. It is assumed that no imported fill will be brought onto the site, and any excess soil generated from site activities will be re-used across the site to fill excavations, foundation post voids, or other area for balanced cut/fill.
8. The cost estimate assumes all general waste has been gathered up in a central location by plant personnel, and material will be stockpiled in strategically-established common stockpile areas for ease of transport off-site.
9. All stored lubricants from inverters, transformers, or other equipment will be drained and be brought to a central location for off-site disposal.
10. Assumes two-in-portrait (2P) configuration of modules. Should a one-in-portrait (1P) arrangement be implemented, the quantity of foundation posts, racking, and restoration of disturbances will increase due to the increased footprint and size of the PV array.
11. Access roads are based on 20-foot width, and thickness of 8 inches of compacted stone.
12. The number of PV modules are based on the latest site plan drawing (3/31/2021) which depicts a site plan configuration for a rated capacity of 120 MWac. It is anticipated the project will consist of 512,190 Canadian Solar CS3U-350PB-AG modules, each with a nameplate capacity of 350Wp.
13. The number of inverters is based on the latest site plan drawing (3/31/2021) which depicts a site plan configuration for a rated capacity of 120 MWac. The site plan drawing indicates 44, 4.6 MVA Sunny Central SMA inverters will be used.
14. Removal of foundation post includes backfilling hole with extracted soil.

15. Removal of access road includes removal of stone, gravel, and geotextile fabric. Price includes re-grading, hauling, and disposal of gravel at aggregate reclamation facility. Price includes de-compacting to a depth of 18" and re-seeding.
16. Cost estimate assumes that a step-up substation at the point of interconnect (POI) will include a High Voltage Transformer and roughly 155' x 160' concrete pad foundation pad.
17. Cost estimate assumes the collector conductors will be abandoned in-place, when greater than 48 inches below surface grade.
18. This opinion of probable costs has been created based on the preparing engineer's experience for similarly-sized energy facilities, and available cost reference manuals at the time of preparation. It is possible and likely that the final design of the facility may change the configuration, layout, or listed quantities of items included in the above estimate. The engineer accepts no liability for errors, omissions, or the accuracy and adequacy of this opinion of probable costs. Should the Project, site configuration, or listed quantities change during final design or over the life of the Project, the cost estimate and financial assurance will be updated.

9. Decommissioning Funding: Salvage Value

Table 2 – Raw Materials Salvage Value Estimate for Greens Corner Solar

Item/Task	Quantity	Unit	Unit Price	Total Price
Salvage Value				
Salvage value of steel posts	1,786	Tonne	$200	$357,169
Salvage value of cables and coils (copper)	68,160	Pound	$1.15	$78,384
Salvage value of recoverable module components	537,246	Each	$17.10	$9,186,906
			Total Salvage Value	**$9,622,459**

9.1 Salvage Value of Steel Posts and Cabling/Wiring

Similar to the Gross Decommissioning Costs in Table 1, the salvage value estimate for the steel and copper raw materials from the Project have been estimated in current-day costs (2021-year). The estimate in Table 2, below is provided in current-day costs (2021-year).

The following assumptions were made to estimate raw materials salvage value for the Project:

1. Total salvage value of steel calculated based on 20,500 posts, each 16-ft long (337,760 linear feet). Posts assumed to be W8x12 posts (12 pounds of steel per linear foot), based on two-in-portrait (2-P) module arrangement. Over the past 10 years, the price of salvageable steel has ranged between $200 to $450 per metric ton (2,204 lb). An average steel salvage cost of $200 per metric ton of steel has been considered.[4]
2. Total salvage value of copper based on a high-level estimated length of cable, and 10 gage AWG copper cable for collection (0.0134 pounds of copper per foot length of cable).

9.2 Salvage Value of PV Modules

In addition to the salvage value of the raw materials outlined in Table 2, the Project will also have recoverable value resulting from the potential re-use and re-sale of the PV modules, or the dismantling and salvage of PV modules for recoverable commodity components. The planned module manufacturer, Canadian Solar, standardly offers a twelve (12) year limited product warranty[5]. Although specific negotiations with the manufacturer would need to occur to transfer the warranty to a second-hand buyer, the warranty speaks to the manufacturer's confidence in the product's reliability in the early years of the equipment's useful life and the ability to salvage and re-use modules. While it is anticipated that re-use and re-sale of the PV modules will provide the best-and-highest recoverable value, for the purpose of this Decommissioning Plan, we have included only the value of the PV modules from salvaging recoverable commodity components in our calculation of salvage value.

[4] Steelonthenet, *"Econometric Proce Forecasts – Steel Scrap, Rebar & Hot-Rolled Coil."*, https://www.steelonthenet.com/price-forecasts.html

[5] https://static.csisolar.com/wp-content/uploads/2020/10/04151314/Warranty-of-BiHiKu-Module.pdf

9.2.1 Discussion of Salvageable Components

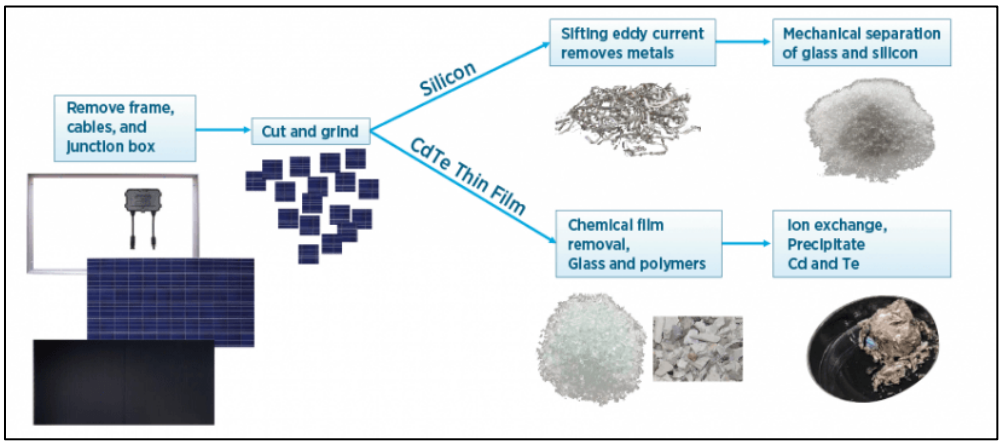
The planned module, Canadian Solar module CS3U-350PB-AG, is a bi-facial polycrystalline silicon panel which is comprised predominantly of aluminum, glass, and plastic. These materials make up approximately 80% of the module's components[6]. Although the market for recycled PV modules has not become significantly established and is still growing, since each of these parent materials are readily recyclable, it is expected that the individual components from these panels, along with copper, silver, and silicon (all collectively representing 99% of the PV module components), will be recoverable.

Module recycling in the United States is supported by the fact that processes are already established in the glass, metals, and electronics industries which can accommodate solar panels and other solar power system components. These processes typically involve crushing, shredding, and milling, usually after removal of the frame and junction box. In these processes, glass, aluminum, copper, silver, and other precious metals may be recovered and the other materials may be disposed of conventionally. While several different methods exist to recycle solar panels, nearly all recycling activities include the following steps:

1. Removal of the aluminum frame and junction box;
2. Separation of the glass and the silicon wafer through thermal, mechanical or chemical processes; and/or
3. Separation and purification of the silicon cells and specialty metals (e.g., silver, tin, lead, copper) through chemical and electrical techniques.

A graphic prepared by the United States Office of Energy Efficiency and Renewable Energy[7] has been provided as Figure 1 to depict the separation and recycling of the various components of modules.

Figure 1 – Commercial Module Recycling Processes



[6] Solar Energy Industries Association (SEIA), *End-of-Life Management for Solar Photovoltaics: Recycling*, Jan. 2020, https://www.seia.org/sites/default/files/2020-01/SEIA-Recycling-Program-Factsheet-January%202020-web_0.pdf

[7] "End-of-Life Management for Solar Photovoltaics." Energy.gov, https://www.energy.gov/eere/solar/end-life-management-solar-photovoltaics.

Currently, two technologies integrate recovery of the primary module components and trace metals. These two methods include the Full Recovery End of Life Photovoltaic Process (FRELP), and the Arizona State University (ASU) designed process. The goal of the FRELP process was to recover the highest mass percent of materials with the least waste, and to recover bulk materials such as glass, aluminum, silver, and copper. The ASU process, on the contrary, was designed to achieve the highest material value. The process was demonstrated with laboratory-scale separation of silver, lead, tin and copper from silicon wafers, as well as the bulk components which are readily available and recyclable. The ASU process conceptually combined the thermal combustion process, separating the wafers from glass and backsheet to allow for complete module recycling. However, unlike the FRELP process which was created and scaled to accommodate recycling of up to 1,300 modules per day, the ASU method is currently undergoing scaling to market-level recycling. Therefore, for the purpose of this Decommissioning Plan, the recoverable items noted in the FRELP process (glass, aluminum, silver, and copper) were considered as recoverable items during the process. Other high-value items such as metallurgic-grade silicon can be recovered but, for the purpose of this Plan, these items have been conservatively omitted in the salvage value calculation. As end-of-life and damaged modules become generated and silicon and other components become more recoverable, the effect will be an increase in the net salvage value of each module into the on-going future.

Under the FRELP process, the main recoverable components of a PV module which are currently being recycled consist predominantly of copper, aluminum, glass, and silver. As mentioned, while up to 99% of the PV module components can be recycled, the end market and current cost and technology associated with salvaging certain components has limited this proportion to approximately 25% of the PV module for the four identified *salvageable and recoverable* components (aluminum: 17.10%; Glass 6.3%; Copper 0.32%; and Silver >0.1%[8]). Other rare earth materials and components (such as silicon) are present in each module; however, based on current market conditions, market conditions, and technologies used to recycle modules, these materials require more effort to separate and salvage than the current value of the components[9]. Therefore, for the purpose of our evaluation, and following FRELP process considerations, this Decommissioning Plan has considered the recycling and salvage of only copper, aluminum, glass, and silver.

9.2.2 PV Module Salvage and Recycling Industry and Supporting Facilities

Within the domestic US, the Solar Energy Industries Association (SEIA) PV Recycling and Working Group has been actively seeking and developing recycling partners through the SEIA's *National Recycling Program* to handle the large, expected influx of panels in future years. Since 2016, *SEIA's National PV Recycling Program* has created a network of cost-effective recyclers that can offer collection, transportation, and recycling services to system owners for retired modules and other system components According to SEIA, "*SEIA's recycling partners have partnered greater*

[8] F Ardente, e. a. (2019). Resource efficient recovery of critical and precious metals from waste silicon PV panel recycling. *ScienceDirect*, 160.

[9] National Renewable Energy Laboratory (NREL), *Solar Photovoltaic Module Recycling: A Survey of U.S. Policies and Initiatives*, March 2021, Technical Report NREL/TP-6A20-74124.

than 4 million pounds of PV modules and related equipment since the program launched.". SEIA currently has numerous partners each of whom have numerous facilities across the US[10]. In addition to industry organizations such as SEIA, voluntary industry standards, such as NSF/ANSI 457: *Sustainability Leadership Standard for Photovoltaic Modules and Photovoltaic Inverters*, can also provide a detailed description on PV modules and inverters recycling instead of disposal.

Given the substantially growth of renewable energy within the United States, and New York specifically, it is expected that the throughput, efficiency, and market for module recycling and re-use will become more robust as the industry continues to advance. SEIA has specifically identified New York as a state where SEIA is in the process of adding new partners to perform PV module recycling[11] and therefore the Applicant is anticipating that by the time the Facility may need to be decommissioned after 35 years of operation, these Facilities are anticipated to be accepting PV modules locally in New York. It should be noted that SEIA's current partners are generally existing recycling entities experienced in recycling the critical components which make up PV modules; therefore, these anticipated partners are not necessarily new businesses, but rather existing businesses becoming established in the evolving industry of PV module recycling.

9.2.3 Salvage Value Determination – Greens Corners Solar

The inputs in the below calculations are based on the current and best available information and the professional opinion of the preparing engineer, the inputs and resulting cost determinations are subject to re-assessment based on the anticipated evolution of PV module re-use, recycling, and salvage market conditions, where said re-assessments will be performed as committed by the Applicant in a Decommissioning Agreement with the Facility host communities.

Table 3 – PV Modules Net Salvage Value Estimate per Module

Component	Quantity	Unit	Unit Price	Total Price
Salvage Revenue Value				
Salvage value of PV Module - Aluminum	9.70	pounds	$0.56	$5.43
Salvage value of PV Module - Glass	3.57	pounds	$0.03	$0.11
Salvage value of PV Module - Copper	0.18	pounds	$3.26	$0.59
Salvage value of PV Module - Silver	0.56	oz	$24.75	$13.97
Salvage value of PV Module – Silicon	*~2.5 to 3*	*pound*	*~$0.90*	*(not considered)*
Total Salvage Revenue Value per Module				**$20.10**
Shipping to PV Module Recycling / Salvage Facility Beyond Carried Expense for PV Disposal in Table 1	1	each	$0.00	$0.00
Labor for PV Module Dismantling	1	each	$3.00	$3.00
Total Salvage Expense Value per Module				**$3.00**
Net Salvage Expense Value per Module				**$17.10**

[10] Solar Energy Industries Association (SEIA), SEIA National PV Recycling Program, https://www.seia.org/initiatives/seia-national-pv-recycling-program

[11] Solar Energy Industries Association (SEIA), *End-of-Life Management for Solar Photovoltaics: Recycling*, Jan. 2020, https://www.seia.org/sites/default/files/2020-01/SEIA-Recycling-Program-Factsheet-January%202020-web_0.pdf

The following assumptions were made to estimate the Salvage Value of the PV Modules:

1. The quantity represents the salvageable and recoverable quantity for each component.
2. Each Canadian Solar PCS3U-350PB-AG module has a weight of 56.7 pounds
3. The Aluminum, Glass, and Copper Quantities are determined at the following ratios of the total PV module weight: aluminum: 17.10%; Glass 6.3%; and Copper 0.32%[12].
4. The Silver Quantity present in a PV module is determined as 0.044 pounds (20 grams or 0.71 oz)[13], however, the European Commission's Waste from Electrical and Electronic Equipment (WEEE) directory lists the recovery of silver from recycled PV modules at 80% since the year 2018 . Therefore, the salvageable and recoverable Quantity silver noted above has been appropriately reduced to 0.035 pounds (16 grams or 0.56 oz) per module.
5. The salvage value prices (as of September 9, 2021) for each of the salvageable constituents are as follows: $3.26/lb of copper[14]; $0.56/lb of aluminum[5]; $0.03/lb of glass[15]; $24.75/oz of silver[16].
6. "Shipping to PV Module Recycling / Salvage Facility Beyond Carried Expense for PV Disposal in Table 1" is determined as $0 per module. The "Disassembly, Removal, and Disposal of the PV Modules" as identified in Table 1 is inclusive of the transportation costs anticipated for a disposal to a local New York location. In a scenario where the PV modules are being shipped for dismantling and scrapping for salvage components, the end location is also anticipated to be local in New York and therefore transportation is not anticipated to be above and beyond the expense carried in Table 1. This is supported by SEIA having specifically identified New York as a state where SEIA is in the process of adding new partners to perform PV module recycling[17]. This line item is maintained in this table to ensure it is monitored for any future re-assessments.
7. A value of $3 per module has been assigned for the salvage value reduction associated with the labor required during the stripping process and effort to complete the recovery activity. This cost falls within the book-end ranges of labor costs for PV module recovery seen in both European and US markets[18].

[12] F Ardente, e. a. (2019). Resource efficient recovery of critical and precious metals from waste silicon PV panel recycling. *ScienceDirect*, 160.

[13] DiLallo, M. (2014, August 29). *You can't have solar without silver*. Retrieved from USA Today: https://www.usatoday.com/story/money/markets/2014/08/29/no-silver-no-solar/14756397/

[14] *Current Scrap Metal Prices*. (2021, September 8). Retrieved from iscrapapp: https://iscrapapp.com/prices/

[15] *How Much Is Scrap Glass?* (2020, June 7). Retrieved from Askinglot: https://askinglot.com/how-much-is-scrap-glass

[16] *Live Silver Spot Prices*. (n.d.). Retrieved from MONEX: https://www.monex.com/silver-prices/

[17] Solar Energy Industries Association (SEIA), *End-of-Life Management for Solar Photovoltaics: Recycling*, Jan. 2020, https://www.seia.org/sites/default/files/2020-01/SEIA-Recycling-Program-Factsheet-January%202020-web_0.pdf

[18] National Renewable Energy Laboratory (NREL), *Solar Photovoltaic Module Recycling: A Survey of U.S. Policies and Initiatives*, March 2021, Technical Report NREL/TP-6A20-74124.

10. Decommissioning Funding: Net Decommissioning Cost

A Net Decommissioning Cost Estimate has been estimated in Table 3 below. The negative Net Decommissioning Cost indicates a credit.

Table 4 – Estimated Net Decommissioning Cost Estimate

Gross Decommissioning Cost + Contingency (Table 1)	$7,224,475
Total Raw Materials Salvage Value Estimate (Table 2)	$9,622,459
Net Decommissioning Cost Estimate	**-$2,397,984**