

**Ancram Solar PV, LLC  
Ancram Solar Planning Board Application  
Walden Environmental Engineering  
Hazardous Waste Determination  
3333 State Route 82  
Ancramdale, NY 12503**

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**May 8, 2026**

**PREPARED FOR:**

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Ancram Solar Planning Board Application Comments**1.0 ABSTRACT**

Based on the August 7, 2025 Ancram Planning Board meeting and my submitted August 2025 report, which was presented during that meeting, the SEQR review is deficient. In my opinion, based on approximately 38 years of engineering experience and a Professional Engineer since 1994, which includes over 11 years overseeing the NYSDEC Region 2 (New York City) RCRA (hazardous materials) program (see attached resume), the proposed project will cause long-term significant impacts on the visual resources within the community and long-term significant impacts to the community character. During my professional career, I reviewed hundreds of applications, including the SEQRA applications and EAF forms. As part of my work, I was directly involved in several major hazardous waste projects. Additionally, I attended several training sessions concerning solar panel arrays at solid waste landfills, in which I directly a particular case. This experience informs my statement that the issue regarding hazardous waste generation lacking sufficient information to justify the applicant's response in EAF Part 1 Section D.2.t. More information regarding hazardous waste and glare impacts are necessary for the Planning Board to adequately evaluate the impacts of the proposed project.

**2.0 INTRODUCTION**

As presented during the August 7, 2025 Ancram Planning Board Meeting and stated in my August 7, 2025 and September 22, 2025 Reports, Federal and State regulations **require** the proposed solar panel for this project to have a hazardous waste determination (§6 NYCRR Section 360.1 (b) Applicability and Section 371.3 Characteristics of hazardous waste, and Federal Register Title 40 Chapter 1 Subchapter 1 Part 262). While this is normally only required at the time of disposal, it is required at this time because the surety is very dependent on the results of the hazardous waste determination.

As stated below, some solar panels are hazardous because they fail the TCLP (Toxicity Characteristic Leaching Procedure) levels listed in NYSDEC Part 371 and USEPA Part 262. Therefore, the only method to conduct this required determination is through chemical testing via USEPA SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure.

Based on all of the documents submitted, including Appendix O, there is no hazardous waste determination in the provided documentation. Therefore, without a required hazardous waste determination, the solar at the end of their life cannot be disposed of as dictated by Federal and NYS regulations. This is a similar problem affecting the Town of Ancram with the solar panels on the Town Hall's roof; those panels were determined to be hazardous waste, resulting in a significantly increased cost. Assuming the solar panels will be non-hazardous without TCLP testing, it will only leave the Town of Ancram in significant peril in the case, at the end of this project's life, that the solar panels are in fact hazardous waste and the project owners refuse to pay for their proper disposal.

## **2.0 CONCLUSION**

Until a hazardous waste determination is made and presented in the application package, the surety, which is to protect the Town of Ancram, must conservatively include the cost of disposing of the solar panels at the higher cost as hazardous waste. Hazardous-waste solar panels cost up to 5 times as much as non-hazardous-waste solar panels for disposal. Lastly, the surety costs should not be based on the 2025 cost but rather on the end-of-life cost at that future time; the calculations for end-of-life costs at that time were not presented in the application package.

## USEPA<sup>1</sup>

<https://www.epa.gov/hw/end-life-solar-panels-regulations-and-management#Are%20Solar%20Panels%20Hazardous%20Waste?>

## Are Solar Panels Hazardous Waste?

Hazardous waste testing on solar panels in the marketplace has indicated that different varieties of solar panels have different metals present in the semiconductor and solder. Some of these metals, like lead and cadmium, are harmful to human health and the environment at high levels. If these metals are present in high enough quantities in the solar panels, solar panel waste could be a [hazardous waste](#) under [RCRA](#). Some solar panels are considered hazardous waste, and some are not, even within the same model and manufacturer. **Homeowners with solar panels on their houses should contact their state/local recycling agencies for more information on disposal/recycling.**

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## Overview of Hazardous Waste Regulations

Federal solid and hazardous waste regulations (i.e., [the RCRA requirements](#)) apply to solar panels when they are discarded. When a solar panel reaches the end of its usable life or is otherwise discarded, it becomes solid waste. Solid waste is regulated federally under [RCRA Subtitle D](#) and through state and local government programs.

The discarded solar panel, which is now considered solid waste, may then also be regulated under [RCRA Subtitle C](#) as hazardous waste if it is determined to be hazardous. The most common reason that solar panels would be determined to be hazardous waste would be by meeting the [characteristic of toxicity](#). Heavy metals like lead and cadmium may be leachable at such concentrations that waste panels would fail the [toxicity characteristic leaching procedure \(TCLP\)](#), a test required under RCRA to determine if materials are hazardous waste. If the generator of the solar panels knows from previous experience that the material would fail the TCLP test, they can determine that the waste is hazardous without the need for testing.

While heavy metals are present in most solar panels, there are a variety of manufacturers and models, with different materials used as semiconductors. Because of the variation in design and components, testing has shown that some solar panels may pass the TCLP while others fail.

[Hazardous waste solar panels that are recycled](#) may be able to use regulatory exclusions available under RCRA, including the transfer-based exclusion (Title 40 of the Code of Federal Regulations section 261.4(a)(24)) in states that have adopted the [2015 or 2018 Definition of Solid Waste Rule](#). The transfer-based exclusion is a regulatory exclusion for [hazardous secondary material that is recycled](#), as long as certain criteria laid out in the regulations are followed. This conditional exclusion is designed to encourage recycling of materials by third parties while still providing a regulatory framework that prevents mismanagement.

## **Types of Solar Panels**

The two most common types of solar panels are crystalline-silicon and thin film solar panels.

### **Silicon Solar (mono- and poly-crystalline)**

Crystalline-silicon solar PV represents over 95 percent of solar panels sold today. This type of panel contains solar cells made from a crystal silicon structure. These solar panels typically contain small amounts of valuable metals embedded within the panel, including silver and copper. Crystalline-silicon solar panels are efficient, low cost, and have long lifetimes, with modules expected to last for 25 years or longer.

### **Thin-Film Solar**

Thin-film solar cells contain thin layers of semiconductor material, such as cadmium telluride (CdTe) or copper indium gallium diselenide (CIGS), layered on a supporting material such as glass, plastic, or metal. CdTe is the second-most common PV material after silicon, and cells can be made using low-cost manufacturing processes, but their efficiencies aren't as high as silicon solar PV.

## New York State Department of Environmental Conservation<sup>2</sup>

<https://dec.ny.gov/regulatory/regulations/rulemaking-adding-solar-panels-to-the-universal-waste-regulations>

Proposed regulations. They do not appear to be adopted yet.

As the growth in usage and installation of solar panels, also known as photovoltaic (PV) modules, continues so will the need to know how to manage these solar panels as they reach end of life. Because solar panels have a functional life of about 30 years, a sharp increase in the number of end of life solar panels is expected in the coming decades. The United States may generate up to [1 million metric tons of PV waste by 2030 and up to 10 million metric tons of PV waste by 2050](#)

. The majority of this waste is expected to be generated by the utility sector. Most of this waste currently goes to landfills despite heavy metals present in some PV cells that could classify them as hazardous waste (e.g., arsenic, cadmium, lead, silver).

DEC is considering adding solar panels to the Universal Waste (UW) rule. The UW rule, established by EPA in 1995, is a set of reduced requirements for certain commonly generated hazardous wastes. It was created to streamline the collection and recycling of hazardous waste. Recycling helps to prevent hazardous wastes from ending up in landfills while also allowing finite resources to be recovered and avoid resource depletion. Although EPA has not added this waste stream to the federal UW rule, DEC believes that hazardous waste solar panels are misidentified and diverted to non-hazardous waste management streams, both intentionally and unintentionally, and require an improved set of regulations for end of life management. Many consumers believe that products sold to the general public are unlikely to be hazardous wastes when discarded, but that is often not the case.

### **Waste is generated from different stages of the PV life cycle:**

- Scrap from the manufacturing process
- Panels damaged during manufacturing, shipment and handling
- Panels damaged by extreme weather
- Panels replaced due to technological upgrades
- Panels discarded after they reach end-of-life

### **Components that can be recycled from PV waste:**

- Glass (represents 8% of the material value)
- Plastics in the insulating layer, backsheet, and junction box
- Aluminum (represents 26% of the material value)
- Silicon (represents 11% of the material value)
- Copper (represents 8% of the material value)
- Other metals (Zn, Ni, Sn, Pb, Cd, Ga, In, Se, Te)
- Semiconductors in the solar cells
- Sealants
- Silver (represents 47% of the material value)

Ancram Solar Planning Board Application Comments**The potential obstacles for recycling:**

- There's no standard or widespread method of recycling
- There are many types of solar panels and they may need to be recycled differently depending on the construction and chemistry of each type of panel
- Recycling processes are still being developed
- Foreign countries are no longer accepting plastics from the United States
- The value of metals recovered from solar panels can fluctuate and some have been dropping in value
- Glass needs to be pure to be recycled

## Solar Panel Disposal Cost<sup>3</sup>

The cost of solar panel disposal cost is extremely variable. It appears to be based on the perspective and therefore the only reliable numbers are actually quotes from disposal and recycling facilities in 2025.

The <https://www.empirecenter.org/publications/renewable-solar-comes-with-recurring-waste-costs/> website (2023) states “The second option is to dispose of them in landfills. Because they contain toxic metals, they should be sent to hazardous waste landfills, where disposal costs are around \$5 per panel. However, many are sent to municipal solid waste landfills, where disposal costs may be as little as \$1 to \$2 per panel.” See <https://e360.yale.edu/features/solar-energy-panels-recycling> for more details.

The <https://nenpower.com/blog/how-much-is-the-waste-solar-panel/> website (2025) states “*The cost of waste solar panels can vary significantly depending on several factors such as the type of panel, its condition, regional pricing, and specific recycling options available. 1. The price of waste solar panels can range between \$10 and \$50 per panel, 2. Disposal and recycling costs may add an additional \$10 to \$25 per panel, 3. Environmental regulations impact handling procedures, 4. Emerging technologies may influence future pricing trends.*”

## Solar Panel Glare<sup>4</sup>

[<https://www.pagerpower.com/news/common-misconceptions-surrounding-glint-and-glare/>]

- **Misconception 1: ‘Solar panels do not produce glare due to their anti-reflective coating’**

This is probably the most common misconception we come across when it comes to comments regarding solar reflections from solar panels. It is often said that ‘solar panels are designed to absorb sunlight’ and that ‘solar panels have an anti-reflective coating which eliminates glint and glare effects’. From a physics perspective, no coating will ever eliminate reflections. If this were the case, you wouldn’t be able to see the solar panels as the light would never reach your eyes.

Of course, as stated in the website <https://www.pagerpower.com/news/common-misconceptions-surrounding-glint-and-glare/>, “the key issue is specular reflections when it comes to glare. Whilst many solar panels have anti-reflective coatings that will reduce the intensity of any specular reflection, it is shown in Figure 1 [1] below that the majority of coatings only make marginal differences of the percentage of sunlight reflected. This is because most solar panels have a shiny surface or glass panel to protect it, whilst still letting light through. Shiny surfaces, such as glass, are capable of producing specular solar reflections and this is the main cause of glint and glare effects.

The graph also shows how the percentage of reflected light changes with the angle of incidence from the four common solar panel surface types. The graph shows a rather surprising result, in that the percentage of reflected light changes marginally depending on the surface type modelled. Only solar panels that are ‘deeply textured’ reflect relatively low levels of incoming light across all angles of incidence. It is understood however that solar panels with a deeply textured surface are often not viable for an actual PV development due to cost and the current availability of the technology. At most, manufacturers typically claim to produce solar panels with an ‘anti-reflective coating’. Only in borderline circumstances may the percentage of reflected light be reduced through the implementation of ‘rougher’ panel surfaces such that the intensity of reflectance reaches acceptable levels. i.e. trying to eliminate ‘yellow’ glare towards aviation receptors. “

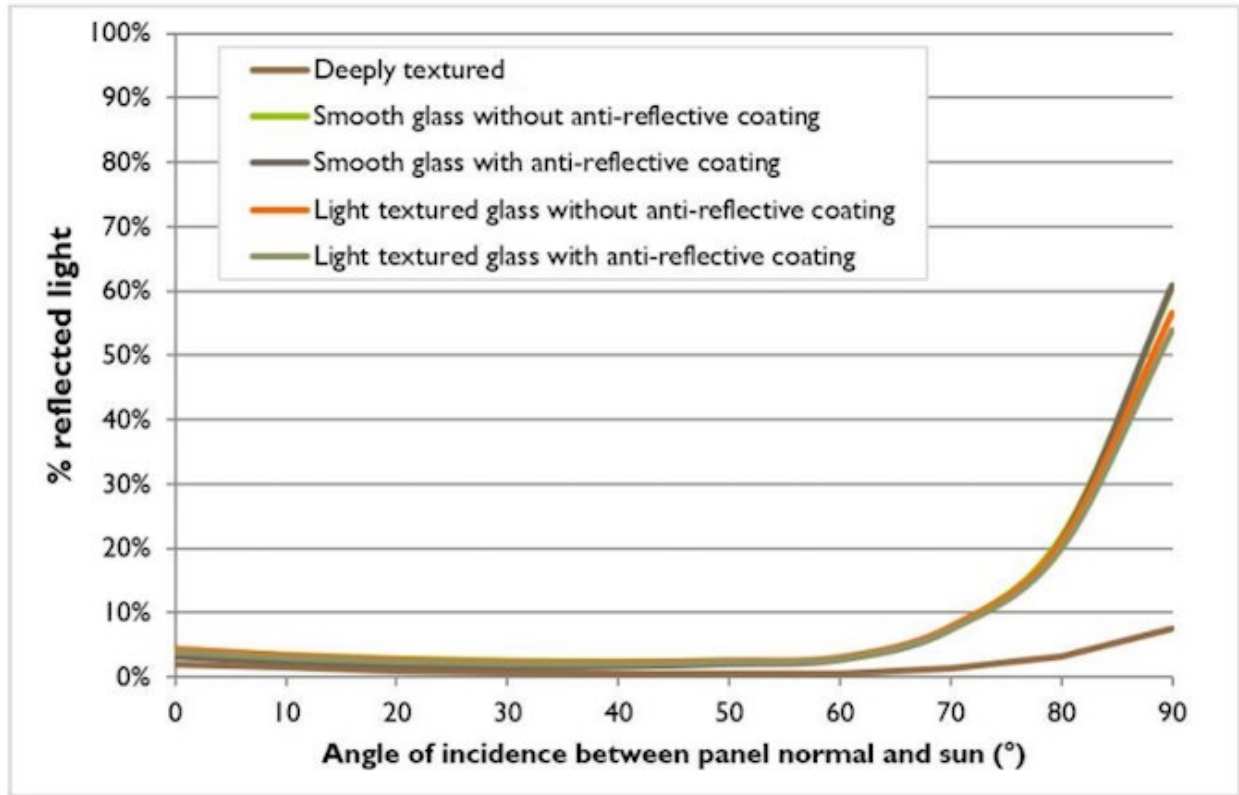


Figure 1: Reflectance profiles of typical PV module materials.

**Misconception 2: ‘Having views of the panels means you will experience glint and glare’**

Just because you can see the solar panels, it doesn’t mean you will necessarily experience glare from the solar panels. This is a common misconception mostly observed within objections to a development or from media articles surrounding a project. The 3D location relative to the solar panels, their specific layout (azimuth and elevation angle), as well as the pathway of the Sun across the sky at that location will determine where a solar reflection is possible. The size of the solar panel area as a whole will then influence the duration of any solar reflection at a location. Therefore, there are only specific locations where glint and glare effects can occur.

It is true however that if you cannot see the face of the solar panel, then no glint and glare effects are possible.

**Misconception 3: ‘South-facing panels produce reflections towards the south’**

Generally speaking, south-facing panels in the northern hemisphere, and north-facing panels in the southern hemisphere do not produce solar reflections directly south towards ground-based receptors when positioned at typical elevation angles (10-35 degrees). In

most cases, solar reflections are cast between northeast and southeast, and southwest and northwest of the panel area.

#### **Misconception 4: ‘Tracking solar panels eliminate glare’**

This all depends on the receptors and the tracking panel characteristic. It is possible to eliminate glare effects at ground level by changing the rest angle of the panels (assuming a typical single axis tracker system), however this requires detailed modelling (which is site specific) because it is dependent on the relative 3D location of the ground-based receptors to the solar panel area. For aviation receptors however, solar reflections may still be produced skyward during the tracking process. In summary, whilst in most cases tracking systems can be programmed to reduce glare, this isn’t inherently the case.

#### **Misconception 5: ‘I don’t need to do a glint and glare assessment for my development’**

It is true that a planning authority or stakeholder may not request a glint and glare assessment however, we are more and more often receiving last-minute inquiries for glint and glare assessment regarding projects that are already in planning and require quick turnaround times. It is therefore worthwhile investigating the requirement for a glint and glare assessment to avoid unnecessary time and financial pressures late on in the project timeline.

#### **About Pager Power**

Pager Power has undertaken over 600 glint and glare assessments around the world including Europe, India, Australia, and South Africa. For more information about [what we do](#), please [get in touch](#).

#### **References**

[1]Yellowhair, J. and C.K. Ho. Assessment of Photovoltaic Surface Texturing on Transmittance Effects and Glint/Glare Impacts. ASME 2015 9th International Conference on Energy Sustainability collocated with the ASME 2015 Power Conference, the ASME 2015 13th International Conference on Fuel Cell Science, Engineering and Technology, and the ASME 2015 Nuclear Forum. 2015. American Society of Mechanical Engineers.

Thumbnail image accreditation: Michael Wilson (November 2019) from Unsplash.com. Last accessed on March 28 2022. Available at: <https://unsplash.com/photos/jld4MmOc4Uk>

Ancram Solar Planning Board Application Comments

## Kenneth B. Brezner, P.E.

### Project Manager III



Mr. Brezner is a Professional Engineer with extensive experience in all aspects of regulating materials management, including solid waste, active hazardous waste, and pesticides. Significant projects include project management ranging from the closure of the entire Fresh Kills Landfill, closure of several other major landfills, permitting of the four New York City (NYC) Marine Transfer Stations, project manager for the NYC Solid Waste Management Plan, and regulating all of the solid waste facilities in NYC.

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## SELECTED RELEVANT EXPERIENCE

### Regional Materials Management Engineer, New York State Department of Environmental Conservation

### EDUCATION

*Post Graduate in Chemical Engineering, Clarkson University*

*Bachelors in Chemical Engineering, Rensselaer Polytechnic Institute*

### LICENSES/ CERTIFICATIONS

Professional Engineer (P.E.) licensed in NY, NJ, and CT

HAZWAPOR – 40 Hours Certification and 8 Hour Refresher

OSHA – 30 Hours Construction Safety and Health Certification

- Managed the NYC Region Materials Management Unit. Supervised three groups (Solid Waste, Active Hazardous Waste, Pesticides) with up to 20 professional staff. This included administrative responsibility (interviewing/hiring and discipline, oversight of the environmental monitor program, budget/purchasing, equipment inventory) and technical responsibility (oversight of an environmental soils laboratory, technical oversight).
- Project Manager for the Fresh Kills Landfill. Reviewed and approved all aspects of the landfill, including landfill closure design/modifications, landfill closure certification reports, slope stability, groundwater monitoring, stormwater management, landfill gas management, financial assurance, environmental analysis, World Trade Center issues, geotechnical issues, end-use projects, and legal issues.
- Project Manager for the DSNY Marine Transfer Stations. Reviewed all aspects of the 91<sup>st</sup> Street Marine Transfer Station, including compliance with the New York State solid waste, wetlands, and water regulations, good engineering practices, and sea-level rise. Oversaw technical staff in the permitting of the other three DSNY Marine Transfer Stations.
- Project Manager for all other Solid Waste Landfills in NYC. Reviewed and approved, as the professional engineer in charge, the design for the closure of the Midwood Construction, A&A, and Salem Fields Landfills.
- Project Manager for all fill material projects in NYC. Became a subject matter expert for fill material (historic fill) issues by conducting extensive research, readings, and interviews over 15 years to fully understand fill practices from the 1600s-1920s. Reviewed and approved/denied all fill materials reuse requests in NYC, coordinating extensively with the Natural Resource and Water division staff as well as various city agencies.
- Subject Matter Expert in solid waste especially for the management of fill material and historical fill. Accepted in court as an expert witness in solid waste facilities and management. Have a comprehensive technical expertise in solid waste landfills and other solid waste facilities including their permitting and management.
- Project Manager for the 380 Development/UTEX project. Reviewed and approved, as the professional engineer in charge, all aspects of the project, including landfill closure design, landfill closure certification reports, slope stability, groundwater monitoring, stormwater management, landfill gas investigation, financial assurance, Beneficial Use Determinations/Fill Approval Requests for dredged and fill materials, environmental analysis, geotechnical issues, end-use projects, and legal issues.
- Project Manager for the NYC Solid Waste Management Plan. Point person for the review of the plan of how NYC will manage all of its solid waste for the next 20 years.
- Recycling Coordinator for the agency's NYC Office. Responsible for all matters regarding recycling, including large and community yard/food composting sites, paper/metal/glass/plastic recycling, junk yards/scrap metal dealers, used oil and tire facilities, electronic waste, plastic bag ban issues, public inquiries, construction and demolition recycling, dredge material use, product stewardship issues/questions, textile recycling, and bio-diesel.

Ancram Solar Planning Board Application Comments**Project Management III, Walden Environmental Engineering**

- Provided Subject Matter Expert knowledge, regulatory experience, and technical assistance throughout the company for various solid waste and sewer/water projects. Developed generic CLCPA calculations, including on and off-road co-pollutant emissions, for various types of solid waste projects. Assigned and managed several major solid waste and construction projects overseeing several technical staff.