IOWA DEPARTMENT OF NATURAL RESOURCES
LAND QUALITY BUREAU
SOLID WASTE SECTION

# Solar Panel Recycling and Disposal

The state of Iowa does not currently have laws or rules specific to solar panel disposal or recycling. However, the state does regulate the disposal of solid waste and hazardous materials, and also regulates recycling facilities that may wish to recycle solar panels. In general, parties looking to dispose of solar panels in Iowa must complete a waste determination to assess whether the solar panel or its parts are considered hazardous waste. If they are, they cannot be disposed of in Iowa landfills and would be subject to EPA jurisdiction as a hazardous waste under the Resource Conservation and Recovery Act (RCRA).

**Background on Solar Panel Design**

Photovoltaic (PV) materials and devices convert sunlight into electrical energy. The solar cell is the first building block of a solar panel. An individual PV cell is usually small, typically producing about 1 or 2 watts of power. These cells are made of different semiconductor materials and are often less than the thickness of four human hairs. In order to withstand the outdoors for many years, cells are sandwiched between protective materials in a combination of glass and/or plastics.

To boost the power output of PV cells, they are connected together in chains to form larger units known as modules or panels. Modules can be used individually, or several can be connected to form arrays. One or more arrays is then connected to the electrical grid as part of a complete PV system. Because of this modular structure, PV systems can be built to meet almost any electric power need, small or large.

PV modules and arrays are just one part of a PV system. Systems also include mounting structures that point panels toward the sun, along with the components that take the direct-current (DC) electricity produced by modules and convert it to the alternating-current (AC) electricity used to power all of the appliances in your home.

Solar panels are an increasingly important source of renewable power that will play an essential role in fighting climate change. Although they are safe to use for their intended purpose, the environmental challenge comes when the decision is made to dispose them. Proper disposal will help save precious resources and promote a clean environment.

## Frequently Asked Questions

### What are the types of Solar Panels?

**Q**: How many types of panels are in circulation and what are the main types?

**A**: There are numerous types of solar panels in circulation. The main types are the monocrystalline silicon, polycrystalline silicon, the cadmium telluride (CdTe) types and the newer thin film types such as copper indium gallium selenide (CIS/CIGS).

It is difficult to determine the type just by looking. Most owners will have documentation regarding what they purchased and had installed. This documentation can help with determining proper disposal options.

**Are decommissioned solar panels considered hazardous waste?**

**Q:** When do solar panels become a waste?

**A**: A waste is any material that is discarded. A material is discarded if it is: abandoned, recycled or considered inherently waste-like. In general, a solar panel becomes a waste when: 1) the generator (manufacturer, distributor, transporter, etc.) decides to discard them, and 2) they are disconnected /removed from service.

**Q.** Are disposal regulations for solar panels different for homeowners and businesses?

**A.** Yes, while the Resource Conservation and Recovery Act (RCRA) exempts homeowners from hazardous waste regulations, businesses are not exempt from RCRA and therefore, must make an accurate waste determination. Solar panels from business, just like all business waste, must have a waste determination prior to disposal.

Homeowners are encouraged to work with their landfill or solid waste agency for the proper disposal method, as some landfills may not accept used solar panels, even from homeowners.

**Q**: What can cause a solar panel to be considered a hazardous waste?

**A**: Solar panel waste may include heavy metals such as silver, lead, arsenic, cadmium and selenium, which at certain levels may be classified as hazardous waste.

**Q**: What does data show? What makes the panels hazardous?

**A**: In general, data shows that older silicon panels may be hazardous due to lead solder. Some older silicon panels are hazardous due to hexavalent chromium coatings. Cadmium telluride (CdTe) panels are typically hazardous due to the presence of cadmium. Gallium arsenide (GaAs) panels may be hazardous due to the arsenic contained in the panels. Thin film panels, such as copper indium gallium selenide (CIS/CIGS) panels, may be hazardous due to the selenium present in the panels.

**Q**: What about electronic components associated with the solar panels?

**A**: The electronic components associated with the solar panels (e.g. drivers, inverters, circuit boards) contain all of the common electronic device hazardous constituents such as lead, arsenic, cadmium, selenium, and chromium. So each may be considered hazardous based on the amounts of these materials in the component.

**Q:** Does a generator have to test the solar panels it generates?

**A**: It depends. Sampling and analysis is conducted when determining whether or not a waste is a hazardous waste. However, a generator may use its knowledge and forego sampling and analytical testing, though documentation supporting the determination must be maintained and made available for review. As for any waste, the generator must make the hazardous waste determination and manage the waste as hazardous waste if it determines the waste to be hazardous waste.

**Q**: Are some types and brands of solar panels hazardous waste, and others not?

**A**: Yes, that is possible. Consult with the manufacturer to learn about the product. A database of solar manufacturers and solar products is available at. http://www.enfsolar.com/directory/panel

**Q**: Are there any markings or identifiable traits to look for?

**A**: Just like any manufactured item, the panel should have a make and model number. Identification tags affixed to the solar panel provide specific information such as product name, trade name, and part number. Consult with the manufacturer to learn about the product.

**Q**: What if you know the type of panel? Can you tell if it is hazardous just by knowing what type of solar panel you have?

**A**: No, even when you know the type of solar panel, it is difficult to say if it is hazardous or not without performing testing or without documentation from the manufacturer.

**Q**: Are solar panels electronic devices under the universal waste regulations?

**A**: No. Solar panels are neither electronic devices or universal wastes in Iowa.

**Q:** What kinds of regulatory exclusions or exemptions, if any, apply to solar panels?

**A**: There are no regulatory exclusions or exemptions specific to solar panel disposal, other than the homeowner exemption referenced above.

**Accumulation**

**Q**: Can hazardous waste solar panels be accumulated and/or consolidated together with universal waste or Cathode Ray Tubes (CRT)?

**A:** No. Solar panels are not considered universal waste or a CRT and may not be managed as such. If the solar panel that is being disposed is determined to be hazardous waste, all applicable hazardous waste requirements apply. Accumulation time limits vary with generator status. Typically, a generator will be required to send the solar panels offsite within 90, 180 or 270 days depending upon the facility's monthly hazardous waste generation quantity.

**Training requirements**

**Q**: What kind of training do personnel have to receive on hazardous waste solar panel management?

**A**: Training requirements for generators of hazardous waste depends on the generator's status. Generators that produce no more than 2,200 pounds of non-acute hazardous waste per month are required to comply with personnel training requirements described at 40 CFR section 262.16(b)(9)(iii). Generators that produce more than 2,200 pounds of non-acute hazardous waste per month are required to comply with personnel training requirements described at 40 CFR 262.17(a)(7).

**Managing broken solar panels**

**Q**: How should I manage broken solar panels? Should solar panel debris be swept up and containerized separately from intact panels?

**A**: Whether broken or intact, if the waste is disposed of, a waste determination must be completed to determine if the waste is a hazardous waste. Solar panels determined to be a hazardous waste must be managed according to the hazardous waste regulations. Broken pieces must be cleaned up and properly packaged/containerized to minimize any potential for release of a hazardous material. Containers shall be structurally sound and prevent releases under reasonably

unforeseeable conditions. As a result of panel breakage, any ground contamination not cleaned up would constitute improper disposal of a hazardous waste. When using a spill kit, follow the manufacturer's instructions. A generator who fails to respond to a spill or release within a timely manner may be cited

**Recycling**

**Q**: Where can I find information on recycling solar panels?

**A**: The marketplace for recyclers of photovoltaic panels continues to grow. Many materials associated with such installations have positive scrap value including metal racks and structures supporting the panels, aluminum frames enclosing the panels, as well as copper wire and related electrical equipment associated with the connection to the electric grid. At the very least, the scrap value associated with these materials may help offset the cost of decommissioning. Due to rapidly changing nature of solar technology, the DNR does not currently keep a list of solar panel recyclers, but over time, more companies will offer the recycling of solar panels.

**Additional Information on Solar Panels**

- The Iowa Utilities Board (IUB) provides a Consumer Informational Guide for On-site (Distributed) Generation to help residential or small businesses that are considering installing electric generation on their property
- The Iowa Energy Center developed a Solar PV Energy Guide to help residential or small businesses that are specifically interested in solar installations.
- The United States Department of Energy has a Homeowners Guide to Going Solar.
- The United States Environmental Protection Agency (EPA) has developed a solar panel fact sheet.

The Iowa DNR does not have authority for hazardous wastes in Iowa and it is managed by the EPA Region 7, Lenexa Kansas. This fact sheet is a guidance document only and does not substitute for state, federal, county or city regulations.

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