Solar Panels Are Designed for Decades of **Safe Use & Decommissioning**

For over 20 years, researchers have been exploring potential health and environmental risks associated with the materials used in solar panels. Results consistently show that site contamination risks are exceptionally low, lower than for most other industrial uses.

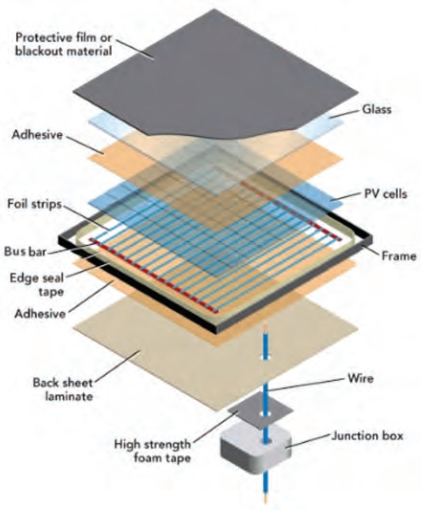
Solar panels use few hazardous materials to begin with. When used, these materials come in very small quantities, and they are sealed in high-strength encapsulants that prevent chemical leaching, even when solar panels have been crushed or exposed to extreme heat or rainwater.

Whether you have solar panels on your roof, you see them in the community, or you design and install them for a living, it's important to understand how solar panels safeguard us, our children, and future generations from exposure to toxic chemicals. In this fact sheet, SEIA summarizes findings from public- and private-sector research, including US and international studies. Read on to find out why modern solar panels are normally categorized as nonhazardous according to a chemical analysis used by the US Environmental Protection Agency (EPA).

Why Solar Panels are Generally Considered Nonhazardous

While **solar panels use mostly common materials with very low toxicity**—glass and aluminum account for over 90 percent of a solar panel's mass—silicon-based solar panels use trace elements of lead for antireflective coating and metallization on solar cells inside the panel. Some thin-film solar panels use cadmium-telluride (CdTe) to form a solid semiconductor compound. CdTe is nonflammable with a melting point over 1,000° Celsius, and it is practically insoluble in water. CdTe is also more stable and far less toxic than elemental cadmium.

Some thin-film solar panels use a compound of copper, indium, and selenium (CIS) to form a semiconductor compound. For all solar panel types, the concentration of toxic chemicals is significantly below EPA values for screening health of air, soil, and water.



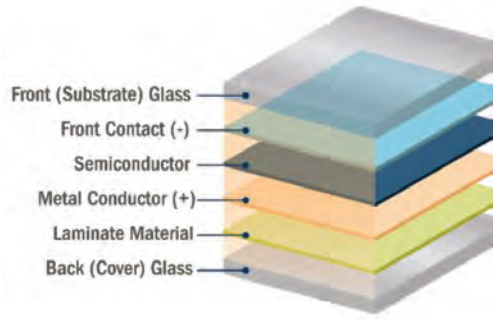
Silicon Panel
Source: PV Junction Box Mounting and Sealing Advances

How Solar Panels Improve Safety

Solar power is improving human health by reducing our reliance on electric power sources that emit toxic chemicals such as sulfur dioxide, nitrogen oxides, and fine particulate matter. The air quality benefits of solar add value to the solar power that fulfills energy needs.

Meanwhile, solar panels effectively utilize and contain chemicals like cadmium, a byproduct of zinc processing, that might otherwise have to be stored or disposed of as toxic waste. By trapping toxicants in a stable compound and sealing them within an encapsulant—the same material that gives strength to storm windows and automobile windshields—**solar panels prevent hazardous materials from entering the environment for as long as the panels are in use,** which could be 35 years or more.

After decommissioning, panels can be recycled or safely disposed of in a sanitary landfill. Even in worst-case scenarios where solar panels are damaged or disposed of improperly, the encapsulant will continue to trap toxicants and prevent them from contaminating soil and groundwater.



CadTel Panel
Source: Achilles' Heel: Cell Cracking

What Makes Solar Encapsulants So Strong

It would take a force of about 725 pounds per square inch to separate a solar panel's encapsulant, which is often made with ethylene-vinyl-acetate (EVA). Solar panels use encapsulants to protect the cells from moisture, UV radiation, and extreme temperatures. The high bond strength of the encapsulant not only shields solar cells from the environment. **It also protects the environment from toxicants used to produce solar cells.**

Researchers have tested the performance of solar encapsulants under adverse conditions, such as by crushing solar panels six times with a landfill compactor applying 50 tons of weight. The remaining pieces retained their front- and backside encapsulation and fragment sizes large enough to prevent chemical leaching.

Similarly, the National Renewable Energy Laboratory has been leading a five-year project, the Durable Module Materials Consortium (DURAMAT), that focuses on two key research goals:

- PV materials and module designs that provide for sustainable, high-energy yield 50-year modules and prevent early failure.
- Examining the characteristics, rates, and mechanisms of long-term degradation in PV modules and what factors influence a rapid increase in degradation at end-of-life.

This effort is a collaboration between NREL and other National Laboratories, academia and scientific research leaders, and the PV industry to address the long-term durability and effectiveness of solar PV modules.

Ongoing Efforts to Mitigate Risks

With SEIA at the forefront, the solar industry exhibits a strong culture of compliance with manufacturing best practices that protect people and the environment. For example, many solar panel producers voluntarily adhere to the European Restriction of Hazardous Substances (RoHS) standard even though the European Union has issued a broad exemption for renewable energy technologies, including solar panels. Some manufacturers have removed lead from the metallization process and are looking for ways to eliminate toxicants from production altogether.

SEIA, as a standards developer accredited by the American National Standards Institute (ANSI), is **setting standards for solar project decommissioning, solar equipment recycling, and end-of-life management.** These standards will help assure proper handling of solar panels throughout the product lifecycle and promote more sustainable use and reuse of solar materials.

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