Solar

Solar Panels are Safe for Your Community

Key Takeaways

1. **Solar panels are made of** materials like glass, aluminum, copper, and semiconductors commonly found in household appliances and technology.
2. In the U.S., the **two most used solar cells**—Crystalline Silicon (c-Si) at 62%[1] of current installations, with Thin Film Cadmium Telluride (CdTe) making up the majority of the remaining market—**do not pose a danger** to human health or the environment.
3. Testing shows that **both c-Si and CdTe panels are safe** in worst-case conditions of abandonment or damage in a disaster.

Background

Solar energy continues to grow rapidly across America. As facilities are proposed in more communities, community members have questions about what materials are included in solar photovoltaic (PV) panels, and if they pose an environmental or health risk to surrounding neighbors.

Explore below the materials in solar panels and how **utility-scale solar facilities are safe for your community.**

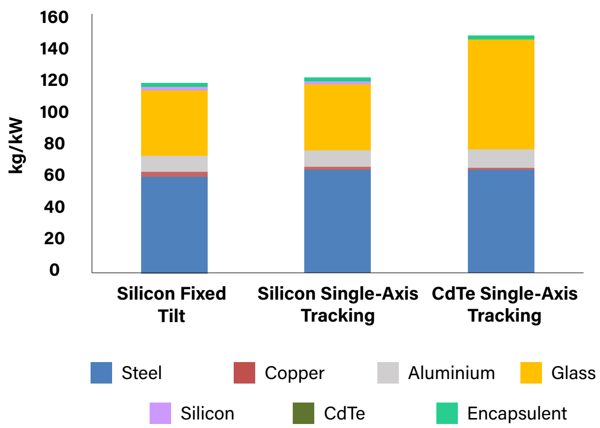
What's inside of a solar panel?

Solar panels are made up of glass, aluminum, copper, and solar cells.

Solar cells are semiconductor materials, made up of thin layers of silicon or other photovoltaic material responsible for converting energy from sunlight into electricity. The thin layer of solar cells is sealed on both sides and covered with glass, a polymer sealant, and—sometimes—an aluminum frame for protection from outside elements.

The main solar cell technologies are crystalline silicon (c-Si) and thin film cadmium telluride (CdTe).

20 MW PW Plant Component Materials by Weight (kg/kW)



Source: U.S. Department of Energy Solar Energy Technologies Office. Photovoltaics End-of-Life Action Plan. March 2022. Accessible: https://www.energy.gov/sites/default/files/2022-03/Solar-Energy-Technologies-Office-PV-End-of-Life-Action-Plan_0.pdf

Can solar panels leach chemicals or metals?

Solar panels are designed and manufactured to withstand harsh environmental conditions and extreme weather events. These hardened structures protect the solar cells from the elements and support plans to keep the facilities operating for up to 40 years.

Extended-stress testing[2] and leaching tests reflective of real-world conditions show that crystalline silicon and thin film cadmium telluride **solar panels pose little risk of leaching during operation, removal and disposal**, including in the event of a natural disaster. In order to operate, the internal components of modules must be protected from the elements, particularly moisture, to prevent corrosion and the release of materials.[3]

Furthermore, the Environmental Protection Agency requires that solar panel modules pass toxicity characteristic leaching procedure (TCLP) testing before being disposed of in a landfill. TCLP testing assesses impacts of landfill conditions on solar panels, including leaching potential. This test is typically conducted during manufacturing to ensure the solar panels will meet the requirements of disposal at end-of-life.[4] **Testing shows that both c-Si and CdTe panels are safe in worst-case conditions of abandonment or damage in a disaster.**[5]

Are the materials in solar panels safe?

Solar panels do not contain sufficient hazardous materials to pose a danger to the environment and human health.

Even in the event of breakage or fire, studies show that crystalline silicon and thin film cadmium telluride solar panels do not pose a danger to the environment or human health.[6,7]

Crystalline Silicon (c-Si) Panels

The primary component in crystalline silicon solar cells is silicon, the second-most common element on earth and found in most consumer electronics, from cell phones to computer chips.[8,9]

- An assessment by the Ohio Department of Health highlighted the safety of crystalline silicon panels, concluding "Information to date does not indicate a public health burden from the use of crystalline silicon (c-Si) in solar farms...[as] crystalline silicon itself is **non-toxic to humans**."[10]

Other components used in c-Si cells include gallium, which is increasing in popularity over boron for putting cells together,[11] and phosphorus—both of which are also non-hazardous to the environment and human health. Most commercially available crystalline silicon panels contain trace amounts (less than 0.1%) of lead used to join the c-Si cells; however, manufacturers are seeking to decrease the use of lead for this purpose.[12] While a large solar energy project contains hundreds of panels, the leaded portions of the panel are enclosed in nonporous, non-toxic substances like glass and polymer, preventing the lead material from escaping or leaching into the ground.[13,14]

- The amount of lead needed to solder the cells is roughly 1/750th of the amount used in a conventional car battery, or half of the amount in a single 12-gauge shotgun shell.

Cadmium is sometimes used in trace amounts in c-Si solar panels for glass frit, the material used in the electrodes to make electrical contact with the PV cell. It may also be found in the solder that is used to join cells. According to the North Carolina Clean Energy Technology Center, research demonstrates the amount of **cadmium found in c-Si solar panels poses negligible toxicity risk to public health** and safety, even in the case of breakage.[15]

Thin Film Cadmium Telluride (CdTe) Panels

Thin film cadmium telluride (CdTe) panels are increasing in popularity, making up about 32% of total installations from 2007-2022, and 38% of new (2022) installations.[16]

CdTe solar panels consist of a semiconductor layer fully encapsulated between two sheets of glass and sealed with an industrial laminate. The CdTe semiconductor layer is approximately 3% of the thickness of a human hair. CdTe is a highly stable compound that differs from elemental cadmium due to its strong bonding and extremely high chemical and thermal stability.[17]

CdTe also has a much lower risk of being released and does not dissolve in water.[18]

- Because coal and oil-fired generators routinely emit cadmium, increased use of solar energy reduce public exposure to cadmium.[19]

For every five megawatts of solar power installed, it is estimated that 157 grams of cadmium are prevented from being released into the environment because of the reduction in traditional energy generation.[20]

To discover more about decommissioning solar facilities and disposal, visit What Happens When a Solar Project is Decommissioned and Solar Panel Recycling and Disposal.

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